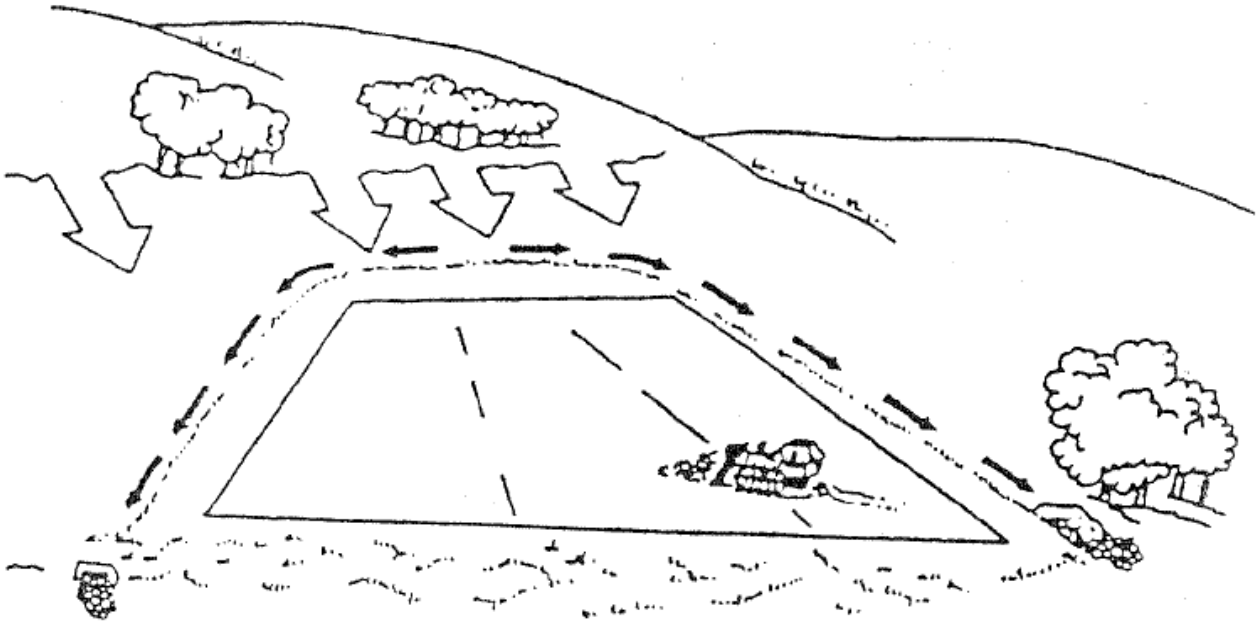


Figure 9-9 Use Of Perimeter Dikes As Diversions

Source: North Carolina Erosion And Sediment Control Manual, 1988.

Construction Guidelines

- Outlet - Diversions shall have adequate outlets which will convey concentrated runoff without erosion.
- Stabilization - Unless otherwise stabilized, the ridge and channel shall be seeded and mulched within 15 days of installation. Disturbed areas draining into the diversion shall be seeded and mulched prior to or at the same time the diversion is constructed.
- All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the diversion.
- The diversion shall be excavated or shaped to line, grade and cross-section as required to meet the criteria specified, and be free of irregularities which will impede flow.
- Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the completed diversion.
- All earth removed and not needed in construction shall be spread or disposed of so that it will not interfere with the functioning of the diversion.
- Permanent stabilization of disturbed areas shall be done in accordance with the applicable standards and specification.

9.6.7 Check Dams

Check dams are small temporary dams constructed across a swale or drainage ditch for the purpose of reducing the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch. Check dams also trap small amounts of sediment generated in the ditch itself; however, these are not sediment trapping practices and should not be used as such. Figure 9-10 illustrates an example check dam.

Some specific applications include the following:

- Temporary ditches or swales which, because of their short length of service, cannot receive a non-erodible lining but still need some protection to reduce erosion.

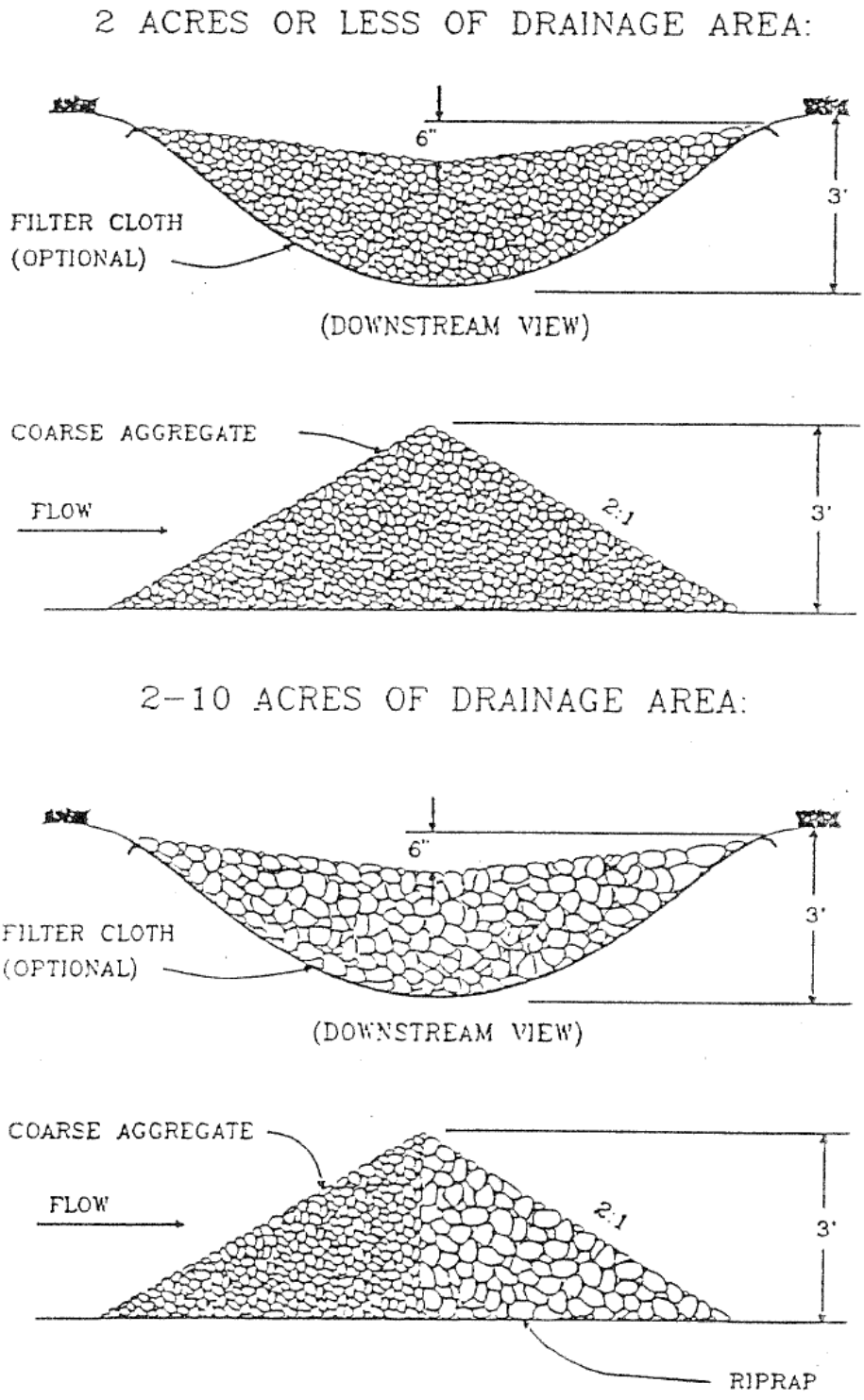


Figure 9-10 Rock Check Dam

Source: LPSNRD 1994.

- Permanent ditches or swales which for some reason cannot receive a permanent non-erodible lining for an extended period of time.
- Temporary or permanent ditches or swales which need protection during the establishment of grass linings

Use Limitations

- Use limited to small open channels which drain 10 acres or less.
- Should not be used in an active stream.
- Should not to be used where high flows or high velocities are expected.
- In locating the check dam, consideration should be given to the effects and the reach of the impounded water and sediment.
- Storm flows across a deteriorated check dam can result in the loss of the structure and the washout of the accumulated sediment.

Design Detailing

- The drainage area of the ditch or swale being protected should not exceed 10 acres. The maximum height of the check dam should be in accordance with Figure 9-10. The center of the check dam shall be at least 6 inches lower than the outer edges. If used in combination, the maximum spacing between the dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

Construction Guidelines

- Stone check dams should be constructed of 2- to 3-inch stone. Hand or mechanical placement will be necessary to achieve complete coverage of the ditch or swale and to insure that the center of the dam is lower than the edges.
- Log check dams may be constructed of 4- to 6-inch logs salvaged from clearing operations on site, if possible. The logs should be embedded into the soil at least 18 inches. The 6-inch lower height required at the center can be achieved either by careful placement of the logs or by cutting the logs after they are in place.
- Logs and/or brush should be placed on the downstream side of the dam to prevent scour during high flows.
- Sediment Removal - Although this practice is not intended to be used primarily for sediment trapping, some sediment will accumulate behind the check dams. Sediment should be removed from behind the check dams when it has accumulated to one half of the original height of the dam.
- Removal - Check dams should be removed when their useful life has been completed. In temporary ditches and swales, check dams should be removed and the ditch filled in when they are no longer needed. In permanent structures, check dams should be removed when a permanent lining can be installed. In the case of grass-lined ditches, check dams should be removed when the grass has matured sufficiently to protect the ditch or swale. The area beneath the check dams should be seeded and mulched immediately after they are removed.

9.6.8 Construction Entrance

A construction entrance is a stabilized stone pad with a filter fabric underliner located at any point where vehicular traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk or parking area. Its purpose is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets. It should be used wherever traffic will be leaving a construction site and move directly onto a public road or other paved area. A construction entrance schematic is shown in Figure 9-11.

Design Detailing

Aggregate Size: Use 2 inch stone, or reclaimed or recycled concrete equivalent.

Thickness: Not less than 6 inches.

Entrance Dimension: 12 foot minimum width and must extend the full width of the vehicular ingress and egress area. 24 foot minimum width if there is only one access to the site. Length shall be as required but not less than 70 feet.

All sediment shall be prevented from entering storm drains, ditches, or watercourses.

Filter Cloth: To be placed on the entire area to be covered with aggregate. The filter cloth shall be woven or non-woven fabric, inert to commonly encountered chemicals, hydro-carbons, mildew, rot-resistant, and conform as a minimum to the fabric properties shown in Table 9-2:

Table 9-2 Properties of Filter Cloth

Fabric Properties[1]	Light Duty Entrance[2]	Heavy Duty Entrance[3]	Test Method
Grab Tensile Strength (lbs.)	180	250	ASTM D4632
Elongation @ Failure (%)	50	60	ASTM D4632
Mullen Burst Strength (psi)	250	380	ASTM D3786
Puncture Strength (lbs.)	90	125	ASTM D4833
Apparent Opening Size (mm)	.20	.20	ASTM D4751
Aggregate Depth (in.)	6	10	ASTM D4751

[1] Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

[2] Light Duty Entrance shall be defined as sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Examples of fabrics which can be used are: Trevira Spunbond 1125, Synthetic Industries 701, Polyfelt TS650, or equivalent.

[3] Heavy Duty Entrance shall be defined as sites with only rough grading and where most travel would be multi-axle vehicles. Examples of fabrics which can be used are: Trevira Spunbond 1135, Synthetic Industries 1001, Polyfelt TS750 or equivalent.

Construction Guidelines

1. The area of the entrance must be excavated a minimum of 3 inches and must be cleared of all vegetation, roots, and other objectionable material. The filter fabric underliner will then be placed the full width and length of the entrance.

2. Following the installation of the filter cloth, the stone shall be placed to the specified dimensions. If wash racks are used, they shall be installed according to the manufacturer's specifications. Any drainage facilities required because of the washing shall be constructed according to specifications.

3. All surface water flowing or diverted towards construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.

4. When washing is required, it shall be done on a area stabilized with stone and which drains into an approved sediment trapping device.

Maintenance

1. The entrance shall be maintained in a condition which will prevent tracking or flow of sediment onto public rights-of-way. This may require periodic top dressing with additional stone or the washing and reworking of existing stone as conditions demand and repair and/or cleanout of any structures used to trap sediment. All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately. The use of water trucks to remove materials dropped, washed, or tracked onto roadways will not be permitted under any circumstances.

STONE CONSTRUCTION ENTRANCE

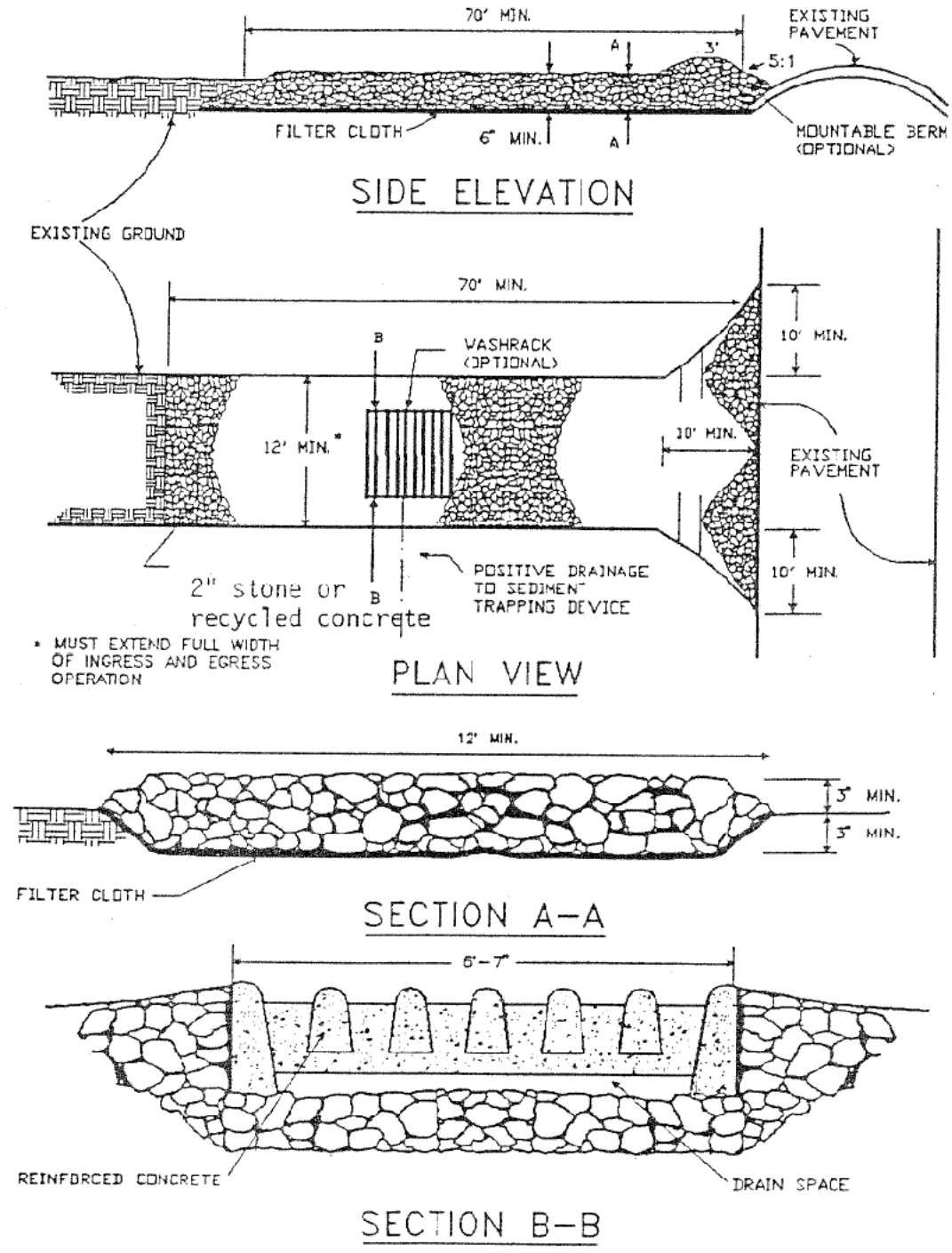


Figure 9-11 Stone Construction Entrance

9.6.9Temporary Vehicular Stream Crossing

A temporary vehicular stream crossing is a temporary structural span installed across a flowing watercourse for use by construction traffic. Structures may include bridges, round pipes, pipe arches, or oval pipes. Its purpose is to provide a means for construction traffic to cross flowing streams without damaging the channel or banks and to keep sediment generated by construction traffic out of the watercourse.

It is generally applicable to flowing streams with drainage areas less than 1 square mile. Structures which must handle flow from larger drainage areas should be designed by methods which more accurately define the actual hydrologic and hydraulic parameters which will affect the functioning of the structure.

Temporary bridge and culvert crossings are presented in Figures 9-12 and 9-13.

Design Detailing

1. Temporary Bridge Crossing
   a. Structures may be designed in various configurations. However, the materials used to construct the bridge must be able to withstand the anticipated loading of the construction traffic.
   b. The temporary waterway crossing shall be at right angles to the stream. Where approach conditions dictate, the crossings may vary 15 degrees from a line drawn perpendicular to the centerline of the stream at the intended crossing location.
   c. The centerline of both roadway approaches shall coincide with the crossing alignment centerline for a minimum distance of 50 feet from each bank of the waterway being crossed. If physical or right-of-way restraints preclude the 50 foot minimum, a shorter distance may be provided. All fill materials associated with the roadway approach shall be limited to a maximum height of 2 feet above the existing floodplain elevation.
   d. A water diverting structure such as a dike or swale shall be constructed (across the roadway on both roadway approaches) 50 feet (maximum) on either side of the waterway crossing. This will prevent roadway surface runoff from directly entering the waterway. The 50 feet is measured from the top of the waterway bank. If the roadway approach is constructed with a reverse grade away from the waterway, a separate diverting structure is not required.
   e. Appropriate perimeter controls such as Silt Fence must be employed when necessary along banks of stream parallel to the same.
   f. All crossings shall have one traffic lane. The minimum width shall be 12 feet with a maximum width of 20 feet.

2. Temporary Culvert Crossing
   a. Where culverts are installed, 2" coarse aggregate or larger will be used to form the crossing. The depth of stone cover over the culvert shall be equal to one half the diameter of the culvert or 12 inches, whichever is greater. To protect the sides of the stone from erosion, riprap shall be used.
   b. If the structure will remain in place for up to 14 days, the culvert shall be large enough to convey the flow from a 2-year frequency storm without appreciably altering the stream flow characteristics. See Table 9-3 for aid in selecting an appropriate culvert size. If the structure will remain in place 14 days to one year, the culvert shall be large enough to convey the flow from a 10-year frequency storm. In this case, the hydrologic calculation and subsequent culvert size must be done for the specific watershed characteristics. If the structure must remain in place over 1 year, it must be designed as a permanent measure by a qualified professional.
   c. Multiple culverts may be used in place of one large culvert if they have the equivalent capacity of the larger one. The minimum sized culvert that may be used is 18 inches.
   d. All culverts shall be strong enough to support the maximum expected load.
   e. The length of the culvert shall be adequate to extend the full width of the crossing, including side slopes.
   f. The slope of the culvert shall be at least 0.25 inches per foot.

PIPE DIAMETER (INCHES) FOR STREAM CROSSINGS[a]				
Drainage Area (Acres)	Average Slope of Watershed			
	1%	4%	8%	16%
1 - 25	24	24	30	30
26 - 50	24	30	36	36
51 - 100	30	36	42	48
101 - 150	30	42	48	48
151 - 200	36	42	48	54
301 - 350	42	48	60	60
351 - 400	42	54	60	60
451 - 500	42	54	60	72
501 - 550	48	60	60	72
551 - 600	48	60	60	72
601 - 640	48	60	72	72

[a] Note: Table is based on USDA-SCS Graphical Peak Discharge Method for 2-year frequency storm event, CN = 65; Rainfall depth = 3.5 inches

Table 9-3 Pipe Diameter (Inches) For Stream Crossings

g. The temporary waterway crossing shall be at right angles to the stream. Where approach conditions dictate, the crossings may vary 15 degrees from a line drawn perpendicular to the centerline of the stream at the intended crossing location .
h. Curbs or fenders may be installed along the outer sides of the deck. Curbs or fenders are an option which will provide additional safety.
i. Bridges shall be securely anchored at only one end using steel cable or chain. Anchoring at only one end will prevent channel obstruction in the event that floodwater floats the bridge. Acceptable anchors are large trees, large boulders, or driven steel anchors. Anchoring shall be sufficient to prevent the bridge from floating downstream and possibly causing an obstruction to the flow.
j. All areas disturbed during installation shall be stabilized within 7 calendar days of that disturbance
k. When the temporary bridge is no longer needed, all structures including abutments and other bridging materials should be removed immediately.
l. Final clean-up shall consist of removal of the temporary bridge from the waterway, protection of banks from erosion, and removal of all construction materials. All removed materials shall be stored outside the floodplain of the stream. Removal of the bridge and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

2. Temporary Culvert Crossing
   a. Clearing and excavation of the stream bed and banks shall be kept to a minimum.
   b. The invert elevation of the culvert shall be installed on the natural streambed grade.
   c. Filter cloth shall be placed on the streambed and streambanks prior to placement of the pipe culvert(s) and aggregate. The filter cloth shall cover the streambed and extend a minimum of six inches and a maximum of one foot beyond the end of the culvert and bedding material. Filter cloth reduces settlement and improves crossing stability.
   d. The culvert(s) shall extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40 feet in length.
   e. The culvert(s) shall be covered with a minimum of one foot of aggregate. If multiple culverts are used, they shall be separated by at least 12 inches of compacted aggregate fill. At a minimum, the bedding and fill material used in the construction of the temporary access culvert crossings shall be 2" coarse aggregate.
   f. When the crossing has served its purpose, all structures including culverts, bedding and filter cloth materials shall be removed. Removal of the structure and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.
   g. Upon removal of the structure, the stream shall immediately be shaped to its original cross-section and properly stabilized.

Maintenance

Both structures shall be inspected after every rainfall and at least once a week, whether it has rained or not, and all damages repaired immediately.

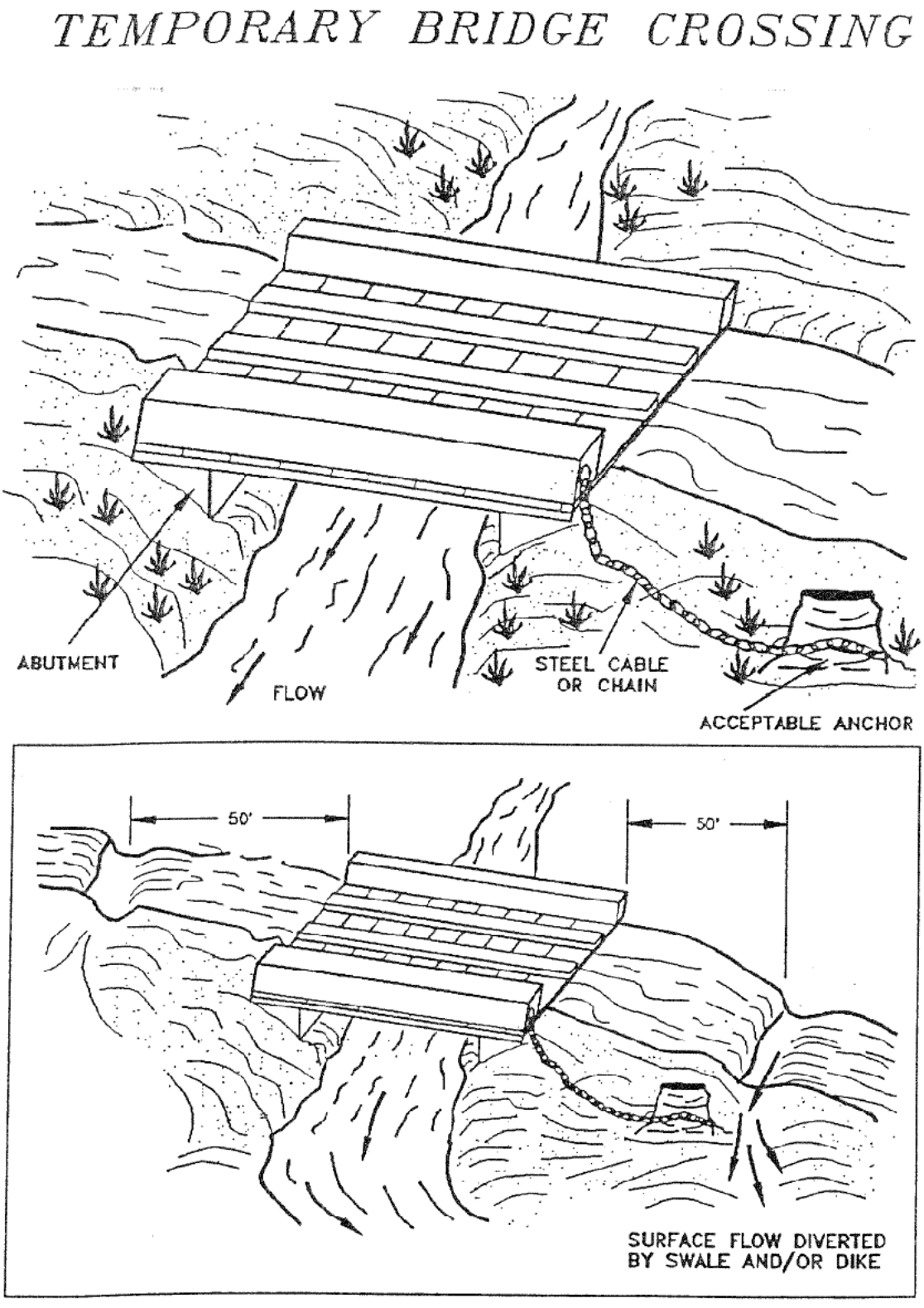


Figure 9-12 Temporary Bridge Crossing

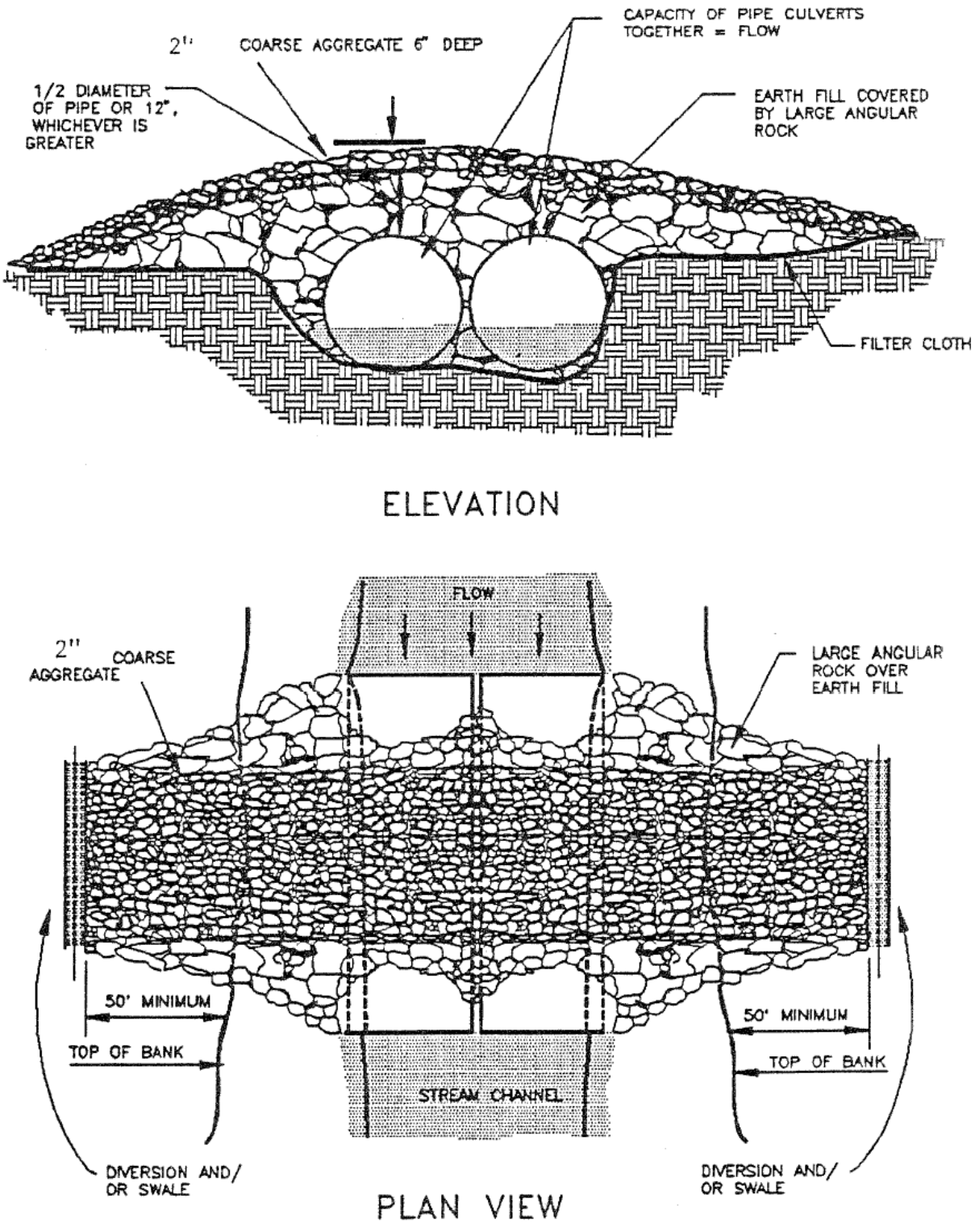


Figure 9-13 Temporary Culvert Crossing

9.6.10 Level Spreader

A level spreader is an outlet for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope. Its purpose is to convert concentrated runoff to sheet flow and release it uniformly onto areas stabilized

by existing vegetation.

A level spreader is applicable where there is a need to divert stormwater away from disturbed areas to avoid overstressing erosion control measures; where sediment-free storm runoff can be released in sheet flow down a stabilized slope without causing erosion. This practice applies only in those situations where the spreader can be constructed on undisturbed soil and the area below the level lip is uniform with a slope of 10% or less and is stabilized by natural vegetation. The runoff water should not be allowed to reconcentrate after release unless it occurs during interception by another measure (such as a permanent pond or detention basin) located below the level spreader.

See Figures 9-14a and 9-14b for level spreader information.

Design Detailing

- Determine the capacity of the spreader by estimating the peak flow expected from a 10-year storm. For flows greater than 20 cfs, the measure shall be designed by a qualified engineer.
- A 20-foot transition section should be formed in the diversion channel so that the width of the diversion will smoothly tie in with the width of the spreader to ensure more uniform outflow. The grade of the channel for the last 20 feet of the dike or diversion entering the level spreader shall be less than or equal to 1%.
- The grade of the level spreader channel shall be 0%.
- The depth of the level spreader, as measured from the lip, shall be at least 6 inches. The depth may be made greater to increase temporary storage capacity, improve trapping of debris and to enhance settling of any suspended solids.
- The length, width and depth of the spreader shall be as follows:

Design Flow (cfs)	Depth (ft)	Width of Lower Side Slope of Spreader (ft)	Length (ft)
0 - 10	0.5	6	10
10 - 20	0.6	6	20

- The release of the stormwater will be over the level lip onto an undisturbed, well-vegetated area with a maximum slope of 10%. The level lip should be of uniform height and zero grade over the length of the spreader. The level lip may be stabilized by vegetation or may be of a rigid non-erodible material depending upon the expected design flow: 0 - 4 cfs may be stabilized by vegetative means, 5 - 20 cfs shall be stabilized by rigid means. A vegetated lip must be constructed with an erosion-resistant material, such as jute or excelsior blankets, to inhibit erosion and allow vegetation to become established. For higher design flows and permanent installations, a rigid lip of non-erodible material, such as pressure-treated lumber or concrete curbing should be used.

Construction Guidelines

- Level spreaders shall be constructed on undisturbed soil (not fill material).
- The entrance to the spreader shall be shaped in such a manner to insure that runoff enters directly onto the 0% channel.
- Construct a 20-foot transition section from the diversion channel to blend smoothly to the width and depth of the spreader.
- The level lip shall be constructed at 0% grade to insure uniform spreading of stormwater runoff.
- Protective covering for vegetated lip shall be minimum of 4 feet wide extending 6 inches over the lip and buried 6 inches deep in a vertical trench on the lower edge. The upper edge should butt against smoothly cut sod and be securely held in place with closely spaced heavy duty wire staples.
- Rigid level lip should be entrenched at least 2 inches below existing ground and securely anchored to prevent displacement. An apron of ½" to 1-1/2" coarse aggregate should be placed to the top of the level lip and extended downslope at least three feet. Place filter fabric under stone and use galvanized wire mesh to hold stone securely in place.
- The released runoff must outlet onto undisturbed stabilized areas with slope not exceeding 10%. Slope must be sufficiently smooth to preserve sheet flow and prevent flow from concentrating.
- Immediately after its construction, appropriately seed and mulch the entire disturbed area of the spreader.

Maintenance

The measure shall be inspected after every rainfall and repairs made, if required. Level spreader lip must remain at 0% slope to allow for proper function of measure. The contractor shall avoid the placement of any material on and prevent construction traffic across the structure. If the measure is damaged by construction traffic, it shall be repaired immediately.

LEVEL SPREADER

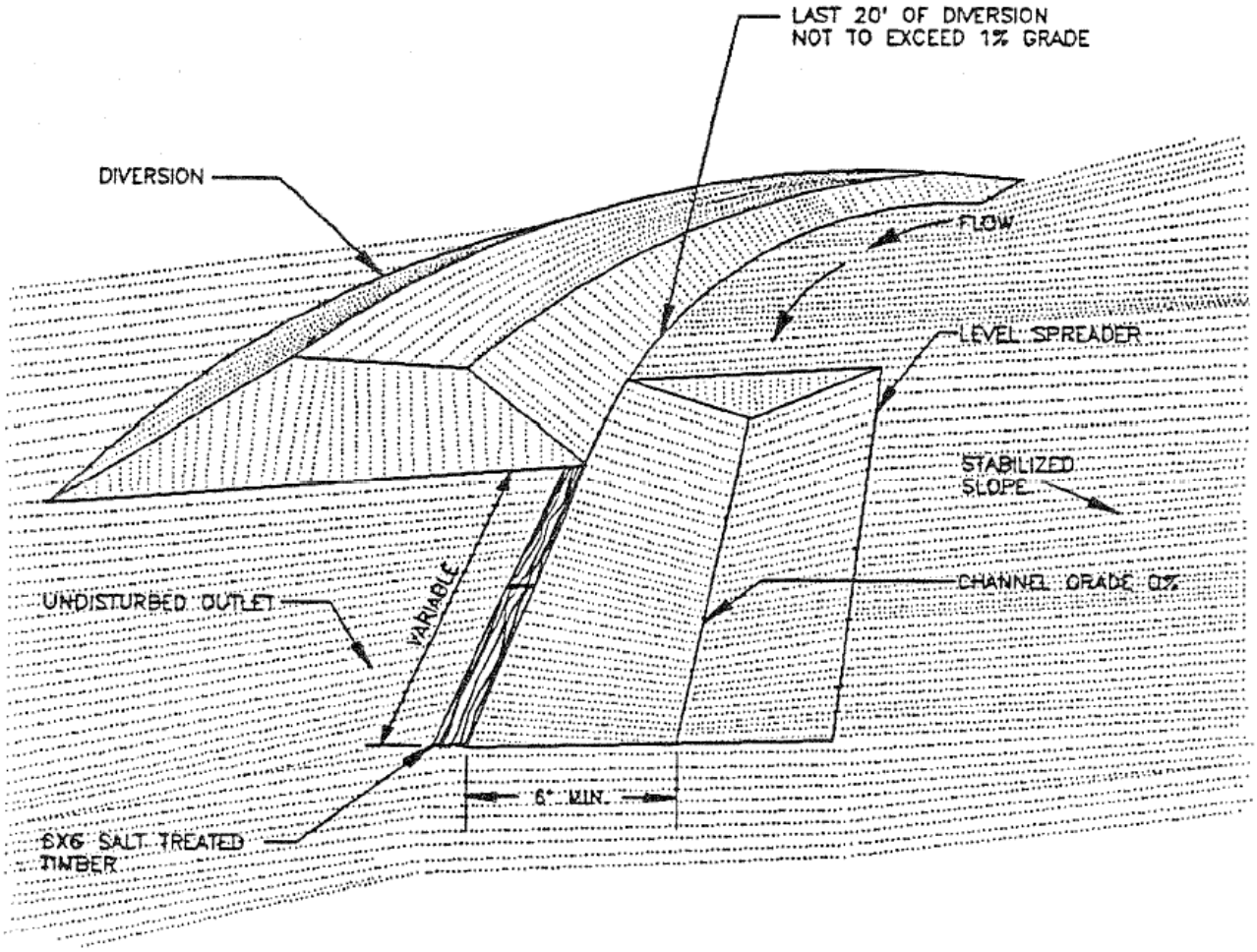
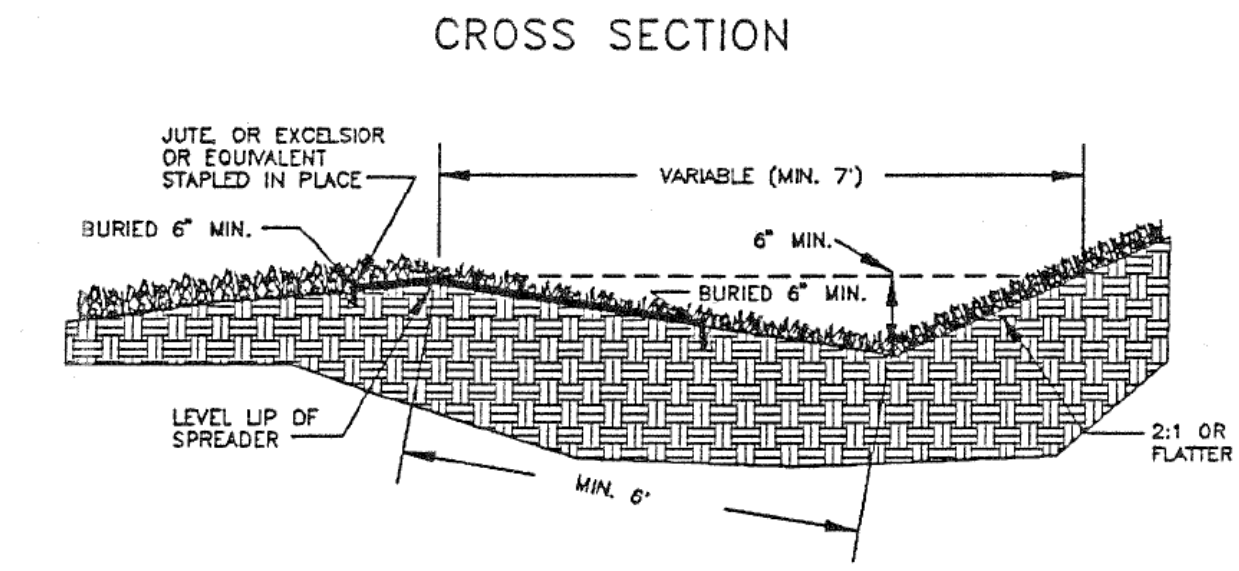


Figure 9-14a Level Spreader Perspective View



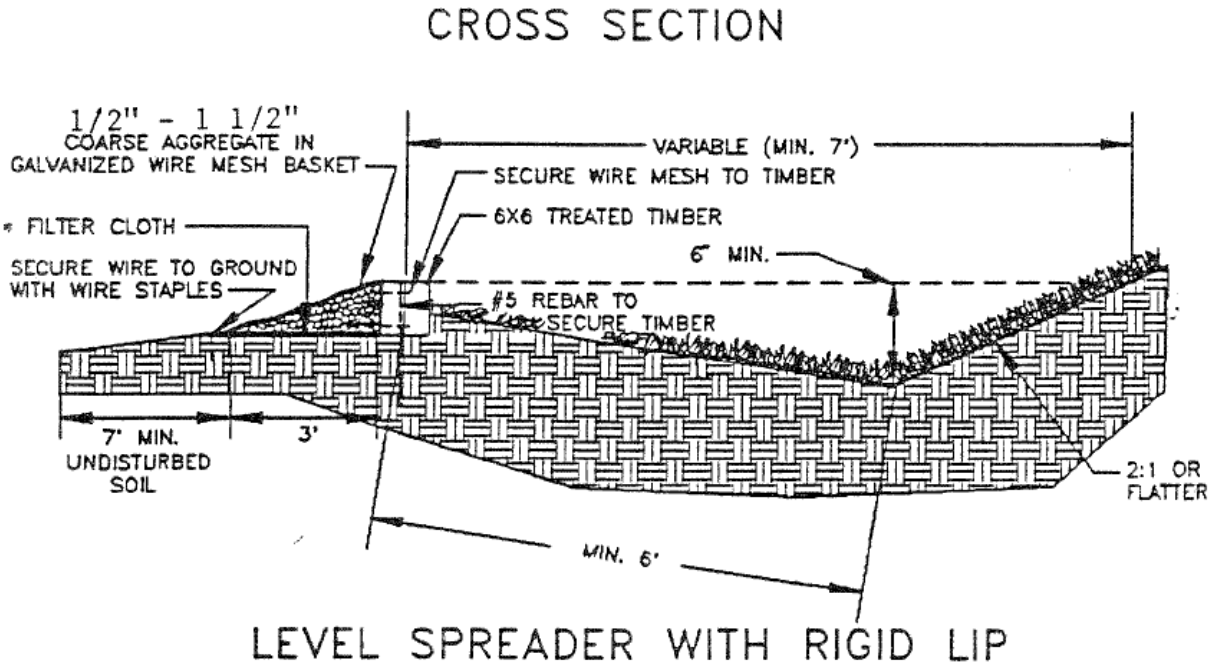


Figure 9-14b Level Spreader Cross-Section

9.6.11 Temporary Sediment Trap

A temporary sediment trap is a temporary ponding area formed by constructing an earthen embankment with a stone outlet. Its purpose is to detain sediment-laden runoff from small disturbed areas long enough to allow the majority of the sediment to settle out. It should be used below disturbed areas where the total contributing area is less than 3 acres and where the sediment trap will be used no longer than 18 months.

Figure 9-15 shows a temporary sediment trap.

Design Details

- Sediment traps should be used only for small drainage areas. If the contributing drainage area is 3 acres or greater, use a temporary sediment basin.
- Sediment traps, along with other perimeter controls intended to trap sediment, shall be constructed as a first step in any land-disturbing activity and shall be made functional before upslope land disturbance takes place.
- The sediment trap must have an initial storage volume of 134 cubic yards per acre of drainage area, half of which shall be in the form of a permanent pool or wet storage to provide a stable settling medium. The remaining half shall be in the form of a drawdown or dry storage which will provide extended settling time during less frequent, larger storm events. The volume of the wet storage shall be measured from the low point of the excavated area to the base of the stone outlet structure. The volume of the dry storage shall be measured from the base of the stone outlet to the crest of the stone outlet. Sediment shall be removed from the basin when the volume of the wet storage is reduced by one-half.

  a. For a sediment trap, the wet storage volume may be approximated as follows:

     $V_1 = 0.85 \times A_1 \times D_1$ where

     V_1 = The wet storage volume in cubic feet.

     A_1 = The surface area of the flooded area at the base of the stone outlet in square feet.

     D_1 = The maximum depth in feet, measured from the low point in the trap to the base of the stone outlet.

  b. For a sediment trap, the dry storage volume may be approximated as follows:

     $V_2 = (A_1 + A_2) / 2 \times D_2$ where

     V_2 = The dry storage volume in cubic feet.

     A_1 = The surface area of the flooded area at the base of the stone outlet in square feet.

     A_2 = The surface area of the flooded area at the crest of the stone outlet in square feet.

     D_2 = The depth in feet, measured from the base of the stone outlet to the crest of the stone outlet.

- The designer should seek to provide a storage area which has a minimum 2:1 length to width ratio (measured from point of maximum runoff introduction to outlet (See Table 9-4).
- Side slopes of excavated areas should be no steeper than 1:1. The maximum depth of excavation within the wet storage area should be 4 feet to facilitate clean-out and for site safety considerations.
- The outlet for the sediment trap shall consist of a stone section of the embankment located at the low point in the basin. A combination of coarse aggregate and riprap shall be used to provide for filtering/detention, as well as outlet stability. The coarse aggregate shall be 3/4 - 1-1/2 inch clean stone (smaller stone sizes will enhance filter efficiency) and riprap shall be NDOR specifications Type A or B filter cloth. Riprap protection shall be placed at the stone-soil interface to act as a "separator". The minimum length of the outlet shall be 6 feet times the number of acres comprising the total area draining to the trap. The crest of the stone outlet must be at least 1 foot below the top of the embankment to ensure that the flow will travel over the stone and not the embankment.
- The maximum height of the sediment trap embankment shall be 5 feet as measured from the base of the stone outlet.

Minimum top widths (W) and outlet heights (H_o) for various embankment heights (H) are shown on the accompanying diagram. Side slopes for the embankment shall be 2:1 or flatter.

- Sediment traps must be removed after the contributing drainage area is stabilized. Plans should show how the site of the sediment trap is to be graded and stabilized after removal.

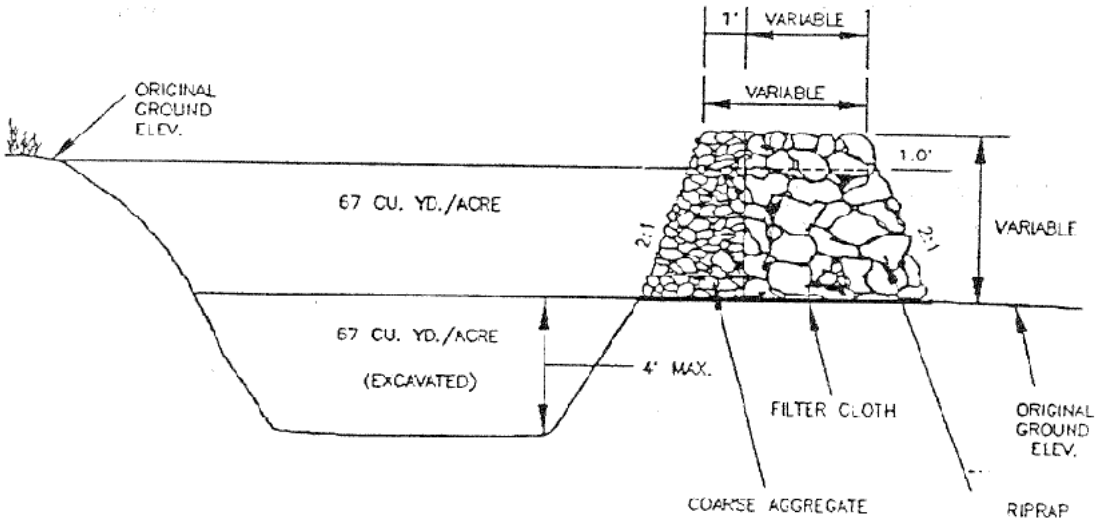
Construction Guidelines

- The area under the embankment shall be cleared, grubbed and stripped of any vegetation and root mat.
- Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment should be compacted in 6 inch layers by traversing with construction equipment.
- The earthen embankment shall be seeded with temporary or permanent vegetation immediately after installation.
- Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
- The structure shall be removed and the area stabilized when the upslope drainage area has been stabilized.
- All cut and fill slopes shall be 2:1 or flatter (except for the excavated wet storage area which may be at a maximum 1:1 grade).

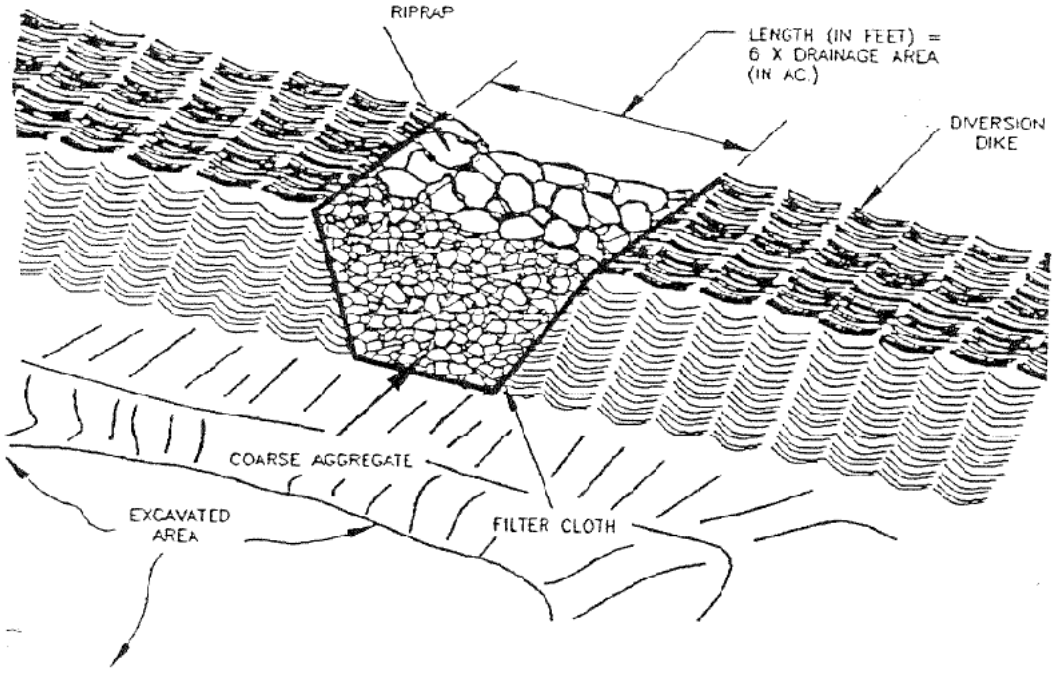
Maintenance

- Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one half the design volume of the wet storage. Sediment removal from the basin shall be deposited in a suitable area and in such a manner that it will not erode and cause sedimentation problems.
- Filter stone shall be regularly checked to ensure that filtration performance is maintained. Stone choked with sediment shall be removed and cleaned or replaced.
- The structure should be checked regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The height of the stone outlet should be checked to ensure that its center is at least 1 foot below the top of the embankment.

TEMPORARY SEDIMENT TRAP

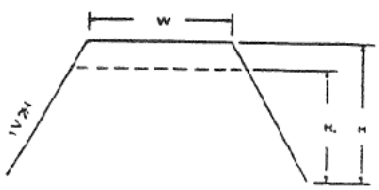


CROSS SECTION OF OUTLET



OUTLET (PERSPECTIVE VIEW)

Figure 9-15 Temporary Sediment Trap



H	H_o	W
1.5	0.5	2.0
2.0	1.0	2.0
2.5	1.5	2.5
3.0	2.0	2.5
3.5	2.5	3.0
4.0	3.0	3.0
4.5	3.5	4.0
5.0	4.0	4.5

Table 9-4 Minimum Top Width (W) Required For Sediment Trap Embankments According To Height Of Embankment (Feet)

Source: Modified From Virginia Erosion & Sediment Control Handbook, 1980

9.6.12 Temporary Sediment Basin

Temporary sediment basins are storage areas provided to detain sediment-laden runoff from disturbed areas long enough for the majority of the sediment to settle out. The facility is a temporary basin with a controlled stormwater release structure, formed by constructing an embankment of compacted soil across a drainageway.

Use Limitations

- Drainage Area and Topography - Temporary sediment basins can be used below disturbed areas generally greater than 5 acres. Sufficient space and appropriate topography for the construction of a temporary impoundment are necessary.
- Longevity - These structures are limited to a useful life of 18 months unless they are designed as permanent ponds by a qualified professional engineer.
- Effectiveness - Sediment basins are at best only 70-80% effective in trapping sediment which flows into them. Therefore, they should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.
- Location - To improve the effectiveness of the basin, it should be located to intercept the largest possible amount of runoff from the disturbed area. The best locations are generally low areas and natural drainageways below disturbed areas. Drainage into the basin can be improved by the use of diversion dikes and ditches. The basin shall not be located in a live stream but should be located to trap sediment-laden runoff before it enters the stream. The basin should not be located where its failure would result in the loss of life or interruption of use of public utilities or roads.
- Multiple Use - Sediment basins may be designed as permanent structures to remain in place after construction is completed. Wherever these structures are to become permanent, or if they exceed the size limitations of the design criteria, they shall be designed as permanent ponds by a qualified professional engineer.

Design Detailing

- Maximum Drainage Area - Unless the structure is designed as a permanent pond by a professional engineer, the maximum allowable drainage area into the basin shall be 150 acres.
- Maximum storage volume and embankment height - Refer to Department of Water Resources regulations.
- Basin Capacity - The design capacity of the basin shall be at least 134 cubic yards per acre of drainage area, measured from the bottom of the basin to the crest of the principal spillway (riser pipe). Sediment should be removed from the basin when the volume of the basin has been reduced to 67 cubic yards per acre of drainage area. In no case shall the sediment cleanout level be higher than 1 foot below the top of the riser. The elevation of the sediment cleanout level should be calculated and clearly marked on the riser. A series of small basins has proven to be more effective in some instances than one large basin and may be better adaptable to a particular site.
- Basin Surface Area - Sediment trapping efficiency is primarily a function of sediment particle size and the ratio

of basin surface area to inflow rate. Therefore, design the basin to have a large surface area for its volume.

- Design Life - Sediment basins with an expected life greater than 18 months shall be designed as permanent structures. In these cases, the structure shall be designed by a qualified professional engineer experienced in the design of dams.
- Basin Shape - To improve sediment trapping efficiency of the basin, the effective flow length shall be twice the effective flow width. This basin shape may be attained by properly selecting the site of the basin, by excavation, or by the use of baffles.
- Embankment Cross-Section - The embankment shall have a minimum top width of 8 feet. The side slopes shall be 2H:1V or flatter. The embankment may have a maximum height of 10 feet if the side slopes are 2H:1V. If the side slopes are 2.5H:1V or flatter, the embankment may have a maximum height of 15 feet.
- Spillway design - The outlets for the basin may consist of a combination of principal and emergency spillways or a principal spillway alone. In either case, the outlet(s) shall pass the peak runoff expected from the drainage area for a 10-year storm without damage to the embankment of the basin. Runoff computations shall be based upon the soil cover conditions which are expected to prevail during the life of the basin. To increase the efficiency of the basin, the spillway(s) can be designed to maintain a permanent pool of water.
- Principal Spillway - The principal spillway shall consist of a solid (non-perforated), vertical pipe or box of corrugated metal or reinforced concrete joined by a watertight connection to a horizontal pipe (barrel) extending through the embankment and outletting beyond the downstream toe of the fill. If the principal spillway is used in conjunction with an emergency spillway, the principal spillway shall have a minimum capacity of 0.2 cfs per acre of drainage area when the water surface is at the crest of the emergency spillway. If no emergency spillway is used, the principal spillway shall be designed to pass the entire peak flow expected from a 10-year storm.

  Design Elevations - If the principal spillway is used in conjunction with an emergency spillway, the crest of the principal spillway shall be a minimum of 1 foot below the crest of the emergency spillway. If no emergency spillway is used, the crest of the principal spillway shall be a minimum of 3 feet below the top of the embankment. In either case, a minimum freeboard of 1 foot shall be provided between the design high water and the top of the embankment.

  Anti-Vortex Device and Trash Rack - A trash rack shall be attached to the top of the principal spillway to prevent floating debris from being carried out of the basin. An anti-vortex device should be considered to improve flow into the spillway.

  Dewatering - As a minimum, provisions shall be made to dewater the basin down to the sediment cleanout elevation. This can be accomplished by providing dewatering in the spillway structure. Dewatering holes shall be no larger than 4 inches in diameter. A stone filter will be required around the spillway structure to prevent loss of stored sediment.

  Base - The base of the principal spillway shall be firmly anchored to prevent its floating. If the riser of the spillway is greater than 10 feet in height, computations shall be done to determine the anchoring requirements. As a minimum, a factor of safety of 1.25 shall be used (downward forces = 1.25 × upward forces).

  Barrel - The barrel of the principal spillway, which extends through the embankment, shall be designed to carry the flow provided by the riser of the principal spillway with the water level at the crest of the emergency spillway. The connection between the riser and the barrel shall be watertight. The outlet of the barrel shall be protected to prevent erosion or scour of downstream areas.

  Anti-Seep Collars - If the pond is not provided with means for releasing the stored runoff between inflow storms, anti-seep collars shall be used on the barrel of the principal spillway within the normal saturation zone of the embankment to increase the seepage length by at least 10%, if either of the following two conditions is met:

  1. the settled height of the embankment exceeds 10 feet, or
  2. the embankment has a low silt-clay content (Unified Soil Classes SM or GM).

  Anti-seep collars shall be installed within the saturated zone. The maximum spacing between collars shall be 14 times the projection of the collar above the barrel. Collars shall not be closer than 2 feet to a pipe joint.

Collars should be placed sufficiently far apart to allow space for hauling and compacting equipment. Connections between the collars and the barrel shall be watertight. Figure 9-16 illustrates anti-seep collars.

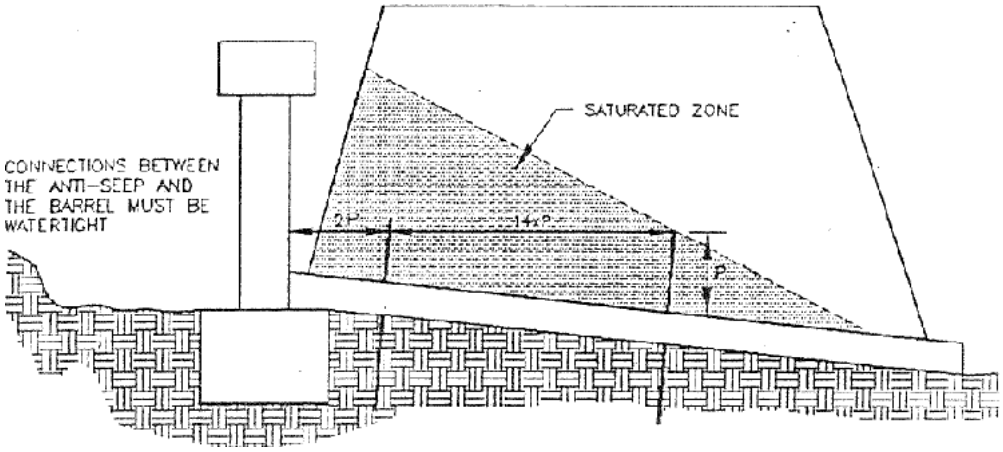


Figure 9-16 Anti-seep Collars

Source: LPSNRD 1994.

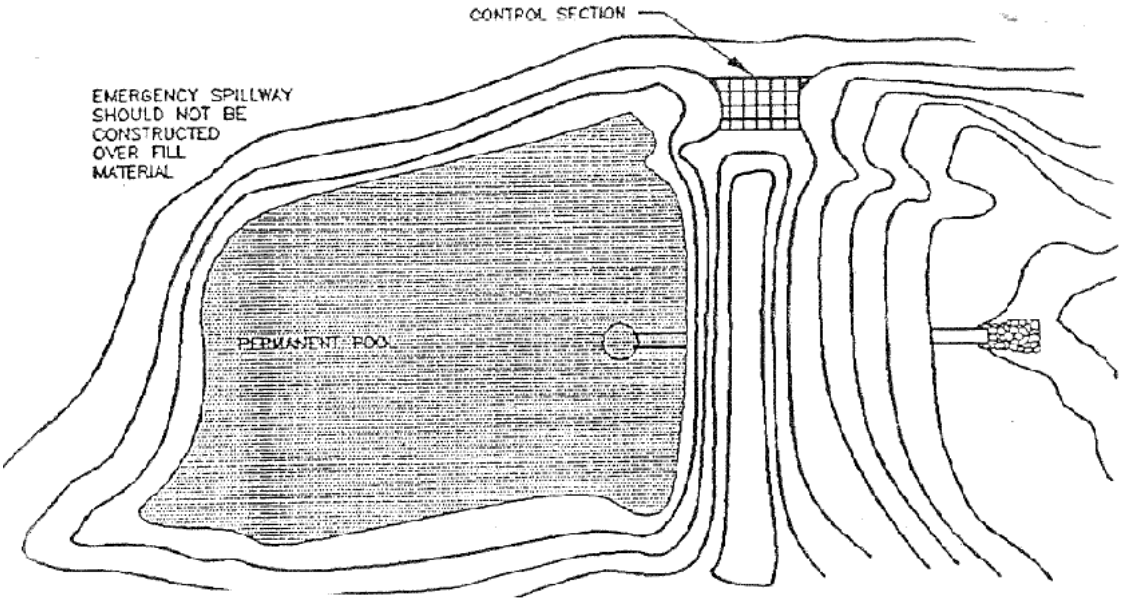


Figure 9-17 Emergency Spillway

Source: LPSNRD 1994.

- Emergency Spillway - The emergency spillway shall consist of an open channel constructed adjacent to the embankment over undisturbed material (not fill). Figure 9-17 illustrates emergency spillways.

  Capacity - The emergency spillway shall be designed to carry the peak rate of runoff expected from a 10-year storm, less any reduction due to the flow through the principal spillway.

  Design Elevations - The design high water through the emergency spillway shall be at least 1 foot below the top of the embankment. The crest of the emergency spillway channel shall be at least 1 foot above the crest of the principal spillway.

  Location - The channel shall be located so as to avoid sharp turns or bends. The channel shall return the flow of water to a defined channel downstream from the embankment.

  Maximum Velocities - The maximum allowable velocity in the emergency spillway channel will depend upon the type of lining used. See Chapter 5 for allowable velocities.

Construction Guidelines

- Site Preparation - Areas under the embankment and any structural works shall be cleared, grubbed and stripped of topsoil to remove trees, vegetation, roots, or other objectionable material. In order to facilitate cleanout and restoration, the pool area (measured at the top of the principal spillway) will be cleared of all brush and trees.
- Cutoff Trench - When a cutoff trench is specified it shall be excavated along the centerline of the dam. The minimum depth shall be 2 feet. The cutoff trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be 4 feet, but wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1H:1V. Compaction requirements shall be the same as those for the roadway embankment. The trench shall be drained during the backfilling-compacting operations.
- Principal Spillway - The riser of the principal spillway shall be securely attached to the barrel by a watertight connection. The barrel and riser shall be placed on a firm compacted soil foundation. The base of the riser shall be firmly anchored according to design criteria to prevent its floating. Pervious materials such as sand, gravel or crushed stone shall not be used as backfill around the barrel or anti-seep collars. Fill material shall be placed around the pipe in 4-inch layers and compacted by hand at least to the same density as the embankment. A minimum of 2 feet of fill shall be hand-compacted over the barrel before crossing it with construction equipment.
- Emergency Spillway - Design elevations, widths, entrance and exit channel slopes are critical to the successful operation of the spillway and should be adhered to closely during construction.
- Embankment - The fill material shall be taken from approved borrow areas. It shall be clean mineral soil, free of roots, woody vegetation, oversized stones, rocks, or other objectionable material. Areas on which fill is to be placed shall be scarified prior to the placement of fill. Fill material will be placed in 6- to 8-inch continuous layers over the entire length of the fill. Compaction shall be obtained by routing the hauling equipment over the fill so that the entire surface of the fill is traversed by at least one wheel or tread track of the equipment, or by using a compactor.
- Vegetative Stabilization - The embankment and emergency spillway of the sediment basin shall be stabilized with temporary vegetation.
- Erosion and Sediment Control - The construction of the sediment basin shall be carried out in a manner such that it does not result in any undue sediment problems downstream.
- Safety - All state and local requirements shall be met concerning fencing and signs warning the public of the hazards of soft sediment and flood waters.

Note: For a detailed discussion of design procedures and specifications for temporary sediment basins, see LPSNRD, 1994.

9.6.13 Temporary Seeding

Temporary seeding is the establishment of a temporary vegetative cover on disturbed areas by seeding with appropriate rapidly growing annual plants. Its purpose is to reduce erosion and sedimentation by stabilizing disturbed areas that will not be brought to final grade for a period of thirty days or more, reduce damage from sediment and runoff to downstream or off-site areas, and to provide protection to bare soils exposed during construction until permanent vegetation or other erosion control measures can be established.

It should be used on exposed soil surfaces. Such areas include denuded areas, soil stockpiles, dikes, dams, sides of sediment basins, temporary roadbanks, etc. A permanent vegetative cover shall be applied to areas that will be left dormant for a period of more than 1 year.

Construction Guidelines

1. Prior to seeding, install all necessary erosion control practices such as dikes, waterways, and basins.

2. Provide proper shaping of the area to be seeded in a manner such that seedbed preparation and seeding operations can be carried out.

3. Seedbed Preparation:
   a. If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted or hardened, the soil surface shall be loosened by discing, raking, harrowing, or other acceptable means. Seedbed preparation should not be undertaken when excessively wet conditions exist. Seedbed shall be prepared to a depth of approximately 3 inches.
   b. If the soil being seeded is fertile topsoil, fertilizer is not required. However, if subsoil is to be seeded, it will most likely be deficient in nutrients required for seed germination and growth. 450 lbs./acre of 10-20-20 fertilizer should be used, and it is essential that this fertilizer be incorporated into the top 2-4 inches of soil during seedbed preparation. Soils which are highly acidic should be limed.

4. Seeding:
   a. Certified seed shall be used on all temporary seedings. Select plants appropriate to the season and site conditions from those listed in Table 9-5:

Table 9-5 Guidelines for Temporary Seeding

Time of Year	Species	Seeding Rate
March 15 - May 15	Spring Oats	2 bu./AC.
	Barley	2 bu./AC.
	Perennial Ryegrass	30-40 lbs./AC.
	Orchard Grass	20-25 lbs./AC.
May 16 - July 15	Grain Sorghum (drilled)	10-20 lbs./AC.
	Forage Sorghum (drilled)	10-20 lbs./AC.
	Hybrid Sundangrass	20-30 lbs./AC.
July 16 - October 15	Spring Oats	2 bu./AC.
	Barley	2 bu./AC.
August 16 - October 15	Winter Wheat	1.5 bu./AC.
	Winter Rye	1.5 bu./AC.
October 15 - March 15	No planting, use mulches	

   b. Seed should be evenly applied with a cyclone spreader, drill, cultipacker seeder, or hydroseeder. Small grains shall be planted no more than 1-1/2 inches deep and grasses no more than ½" deep.
5. When seedings are made on critical sites or adverse soil conditions, mulch material will be applied immediately after seeding. Seedings made during optimum seeding dates and with favorable soils on very flat

areas may not need to be mulched.

Maintenance

Areas which fail to establish vegetative cover adequate to prevent rill erosion will be re-seeded as soon as such areas are identified. Control weeds by mowing.

9.6.14 Permanent Seeding

Permanent vegetation is the establishment of perennial vegetative cover on disturbed areas by planting seed. Its purpose is to reduce erosion and sediment yield from disturbed areas, to permanently stabilize disturbed areas in a manner that is economical, adaptable to site conditions, and allows selection of the most appropriate plant materials, to improve wildlife habitat and to enhance natural beauty. It may be used on disturbed areas where permanent, long-lived vegetative cover is needed to stabilize the soil and rough-graded areas which will not be brought to final grade for a year or more.

Construction Guidelines

1. Prior to seeding, install all necessary erosion control practices such as dikes, waterways, and basins.

2. Provide proper shaping of the area to be seeded in a manner such that seedbed preparation and seeding operations can be carried out.

3. Soil conditions needed for the establishment and maintenance of permanent seeding shall be as follows:
   a. Enough fine-grained material to maintain adequate moisture and nutrient supply.
   b. Sufficient pore space to permit root penetration. A bulk density of 1.2 to 1.5 indicates that sufficient pore space is present. A fine granular or crumb-like structure is also favorable.
   c. Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans shall be 12 inches or more, except on slopes steeper that 2:1 where the addition of soil is not feasible.
   d. A favorable pH range for plant growth. If the soil is so acidic that a pH range of 6.0-7.0 cannot be attained by addition of pH-modifying materials, then the soil is considered an unsuitable environment for plant roots and further soil modification would be required.
   e. Freedom from toxic amounts of materials harmful to plant growth.
   f. Freedom from excessive quantities of roots, branches, large stones, large clods of earth, or trash of any kind. Clods and stones may be left on the slopes steeper than 3:1 if they do not significantly impede good seed soil contact.

   If any of the above criteria cannot be met, then topsoil shall be applied.

4. Seedbed Preparation:
   a. Flat areas and slopes up to 3:1 grade shall be loose and friable to a depth of at least 3 inches. The top layer of soil shall be loosened by raking, discing or other acceptable means before seeding.
   b. Slopes steeper than 3:1 shall have the top 1-3 inches of soil loose and friable before seeding.
   c. When the area is compacted, crusted or hardened, the soil surface shall be loosened by discing, raking, harrowing, or other acceptable means. Seedbed preparation should not be undertaken when excessively wet conditions exist.
   d. Soil amendments shall be applied according to the recommendations of a soil test. When soil testing is not available, apply agricultural grade limestone at the rate of 2 tons/AC; apply 10-20-20 or equivalent nutrients at the rate of 1000 lbs./AC. Lime and fertilizer shall be incorporated into the top 4-6 inches of the soil by discing or other means whenever possible.

5. Seeding:
   a. Design a seed mix by using City of Lincoln approved seed mix. Mixtures for permanent plantings will contain a mixture of two or more species. A single species may be used on some residential or recreational areas.
   b. Certified seed will be used on all permanent seedings. Permanent seedings shall have a minimum of 60 PLS/s.f.
   c. Seed should be evenly applied with a cyclone spreader, drill, cultipacker seeder, or hydroseeder on a firm, moist seedbed. Maximum seeding depth shall be 1/4" on clayey soils and ½" on sandy soils, when using other than hydroseeder method of application.
   d. If hydroseeding is used and the seed and fertilizer is mixed, they will be mixed on-site and the seeding shall be immediate without interruption. A maximum application rate of 150 lbs. Of solids/100 gallons of water is to be used if legume seed is in the mixture.
   e. Cool-season dominant mixtures shall be applied August 15 - April 30. Warm-season dominant mixtures shall be applied October 1 - June 15.
   f. A protective cover crop of annual plants may be seeded for erosion protection until establish of the permanent vegetation. Cover crop planting may be done in conjunction with permanent seeding or immediately after permanent seeding has taken place. Select cover crop plants appropriate to the season and site conditions from those listed in Table 9-6:

Table 9-6 Guidelines for Selecting Cover Crop Plants

Time of Year	Species	Seeding Rate
March 15 - May 15	Spring Oats	2 bu./AC.
May 16 - July 15	Grain Sorghum (drilled)	10-20 lbs./AC.
	Forage Sorghum (drilled)	10-20 lbs./AC.
	Hybrid Sundangrass	20-30 lbs./AC.
July 16 - October 15	Spring Oats	2 bu./AC.
	Winter Wheat	1.5 bu./AC.
	Rye	1.5 bu./AC.
October 15 - March 15	No planting, use mulches	

6. All permanent seedings shall be mulched immediately upon completion of seed application.

Maintenance

1. In general, a stand of vegetation cannot be determined to be fully established until it has been maintained for one full year after planting.

2. New seedings shall be supplied with adequate moisture. Supply water as needed, especially late in the season, in abnormally hot or dry conditions, or on adverse sites. Water applications shall be controlled to prevent excessive runoff.

3. Inspect all seeded areas for failures and make necessary repairs, replacements, and re-seedings within the planting season, if possible.
   a. If stand is inadequate for erosion control, overseed and fertilize using half of the rates originally specified.
   b. If stand is 60% damaged, re-establish following seedbed and seeding recommendations.
   c. If stand has less than 40% cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. The soil must be tested to determine if acidity or nutrient imbalances are responsible. Re-establish the stand following seedbed and seeding recommendations.

9.6.15 Mulching

Mulching is the application of plant residues or other suitable materials to the soil surface. Its purpose is to prevent

erosion by protecting the soil surface from raindrop impact and reducing the velocity of overland flow. Mulch helps foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold. Mulching can be used at anytime where protection of the soil surface is desired. Mulch can be used in conjunction with seedings to establish vegetation, or by itself to provide temporary protection of the soil surface.

Construction Guidelines

1. Site Preparation:
   a. Prior to mulching, install any needed erosion and sediment control practices such as diversions, grade stabilization structures, berms, dikes, grassed waterways and sediment basins.
   b. Complete required shaping of area in a manner such that mulching operations can be carried out.
   c. Soil amendments shall be incorporated and surface roughening accomplished as needed. Seed shall be applied prior to mulching except where seed is to be applied as part of a hydroseeder slurry containing fiber mulch or where seed is to be applied following an organic mulch spread during winter months.

2. Materials:
   a. Organic materials may be used in any area where mulch is required. Select mulch material based on site requirements, availability of materials, and availability of labor and equipment (see Table 9-7).
   b. Mulch materials shall be spread uniformly by hand or machine. When spreading straw mulch by hand, divide the area to be mulched into approximately 1,000 s.f. sections and place 70-90 lbs. (two bales) of straw in each section to facilitate uniform distribution.

3. Anchoring Mulch:

Mulch must be anchored immediately to minimize loss by wind and water. This may be done by one of the following methods (listed by preference) depending upon the size of area, erosion hazard and cost.

a. Mulch Anchoring Tool and Tracking - A mulch anchoring tool is a tractor drawn implement designed to punch and anchor mulch into the top two inches of soil. This practice offers maximum erosion control but is limited to flatter slopes where equipment can operate safely. "Tracking" is the process of cutting mulch into the soil using a bulldozer or other equipment that runs on cleated tracks. Tracking is used primarily on slopes 3:1 or steeper. This practice should be done on the contour whenever possible, except tracking which should be done up and down the slope with cleat marks running across the slope.

b. Mulch Nettings - Staple lightweight biodegradable paper, plastic or cotton netting over the mulch according to manufacturer's recommendations.

c. Liquid Mulch Binders - Application of liquid mulch binders and tackifiers should be heavier at edges, in valleys, and at crests of banks and other areas where the mulch has a greater potential to be moved by wind or water. All other areas should have a uniform application of binder. Binders may be applied after the mulch is spread or may be sprayed into the mulch as it is being blown onto the soil. The use of synthetic binders is the preferred method of mulch binding. Apply at rates recommended by the manufacturer.

d. Wood Cellulose Fiber - The fiber binder shall be applied at a net dry weight of 750 lbs./AC. The wood cellulose fiber shall be mixed with water, and the mixture shall contain a maximum of 50 lbs. Of wood cellulose fiber per 100 gallons of water.

e. Peg and Twine - Drive 8 to 10 inch wooden pegs to within 2 to 3 inches of the soil surface every 4 feet in all directions. Stakes may be driven before or after applying mulch. Secure mulch to the soil surface by stretching twine between pegs in a criss-cross within a square pattern. Secure twine around each peg with two or more turns.

Maintenance

All mulches and soil coverings should be inspected periodically and after each rainstorm to check for erosion. Where erosion is observed in mulched areas, additional mulch should be applied. Nets and mats should be inspected after rainstorms for dislocation or failure. If washouts or breakage occur, re-install netting or matting as necessary after

repairing damage to the slope or ditch. Inspections should take place until grasses are firmly established. Where mulch is used in conjunction with ornamental plantings, inspect periodically throughout the year to determine if mulch is maintaining coverage of the soil surface; repair as needed.

ORGANIC MULCH MATERIALS AND APPLICATION RATES			
MULCHES:	RATES:		NOTES:
	Per Acre	Per 1000 sq. ft.	
Straw or Hay	1½ - 2 tons (Minimum 2 tons for winter cover)	70 - 90 lbs.	Free from weeds and coarse matter. Must be anchored. Spread with mulch blower or by hand.
Fiber Mulch	Minimum 1500 lbs.	35 lbs.	Do not use as mulch for winter cover or during hot, dry periods.* Apply as slurry.
Corn Stalks	4 - 6 tons	185 - 275 lbs.	Cut or shredded in 4-6" lengths. Air-dried. Do not use in fine turf areas. Apply with mulch blower or by hand.
Wood Chips	4 - 6 tons	185 - 275 lbs.	Free of coarse matter. Air-dried. Treat with 12 lbs nitrogen per ton. Do not use in fine turf areas. Apply with mulch blower, chip handler, or by hand.
Bark Chips or Shredded Bark	50 - 70 cu. yds.	1-2 cu. yds.	Free of coarse matter. Air-dried. Do not use in fine turf areas. Apply with mulch blower, chip handler, or by hand.
* When fiber mulch is the only available mulch during periods when straw should be used, apply at a minimum rate of 2000 lbs./ac. or 45 lbs./1000 sq. ft.			

Table 9-7 Organic Mulch Materials And Application Rates

9.6.16 Other Best Management Practices

~~The LPSNRD 1994 *Manual of Erosion and Sediment Control and Stormwater Management Standards* contains detailed specifications and drawings for a number of different erosion and sediment control measures.~~ The following structural control measures are not included herein for brevity, but ~~they are included in the LPSNRD (1994) manual and~~ may be useful in specialized applications.

- Safety Fence
- Brush Barrier
- Temporary Slope Drain
- Road Stabilization
- Utility Stream Crossing (e.g. diversion channel crossing, flume pipe crossing, coffer dam crossing)
- Dewatering Structure (e.g. portable sediment tank, filter box, straw bale/silt fence pit)
- Temporary Fill Diversion
- Turbidity Curtain
- Dust Control
- Surface Roughening
- Lot Benching
- Paved Flumes and Energy Dissipators
- Subsurface Drain
- Structural Streambank Stabilization (e.g. gabions, deflectors, log cribbing, grid pavers)
- Grade Stabilization Structure
- Infiltration Basin
- Infiltration Trench
- Detention Pond
- Extended Detention Pond
- Blankets and Matting
- Stormwater Conveyance Channel
- Vegetative Stream Bank Stabilization
- Topsoiling
- Sodding
- Permanent Diversion
- Filter Strips
- Vegetated Swale
- Temporary Right-of-Way Diversion

9.7 Stormwater Pollution Prevention Plan Requirements

Prior to any land disturbances or grading of any parcel two (2) acres or larger in size; the landowner/land developer shall prepare on forms provided by the City, a “Notice of Intent" (NOI) and a Stormwater Pollution Prevention Plan (SWPPP), following the requirements for a NPDES Permit Number NER 100000, "Construction Site Storm Water General Permit", and in conformance with City ordinances and design standards. An interlocal agreement between the City of Lincoln, the Lower Platte South NRD, and the Nebraska Department of Environmental Quality is in process that will allow approval of one permit application to meet the respective regulatory requirements. See flow chart shown on Figure 9-18.

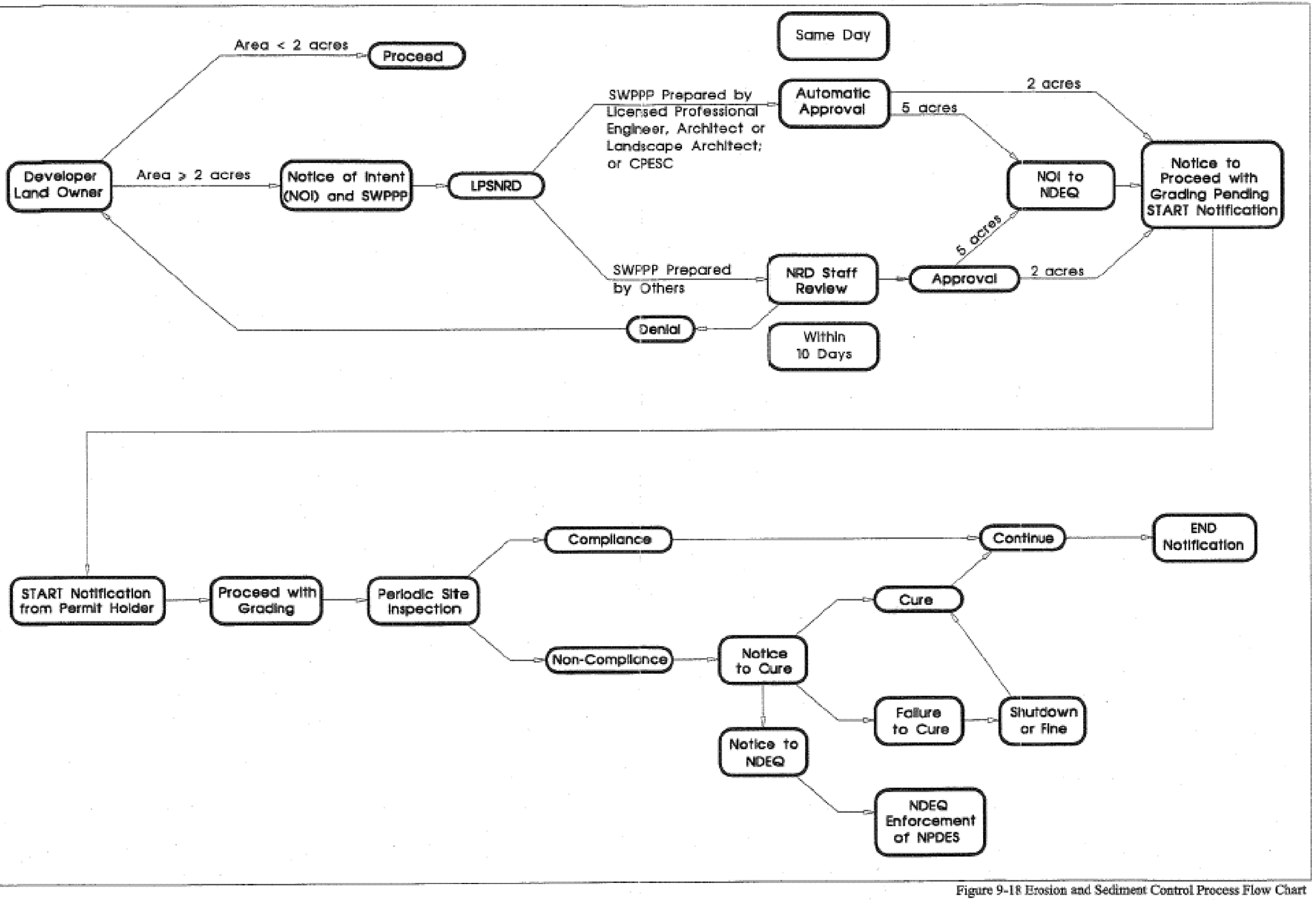


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Figure 9-18 Erosion and Sediment Control Process Flow Chart

9.7.1 SWPPP General Information

The purpose of the SWPPP is to minimize erosion on disturbed areas, minimize the discharge of sediment and other pollutants in storm water runoff, and maintain compliance with the NPDES Permit, state statutes administered by the Lower Platte South Natural Resources District (NRD), and City standards and ordinance regarding erosion and sediment control.

The SWPPP shall be implemented either prior to or concurrent with the initiation of construction activity. SWPPP activities shall be maintained throughout the period construction activities are ongoing until final site stabilization is achieved. A current and updated copy of the SWPPP shall be available on-site at all times that work is being performed. Persons and/or subcontractors responsible for carrying out duties pursuant to the SWPPP shall be properly trained and informed of their responsibilities.

The SWPPP shall be dynamic. If deficiencies in the plan arise during the course of the project, or differing site conditions warrant, the applicant shall implement effective corrective actions that may require modification of the SWPPP.

The City/NRD may require modification of the SWPPP:

1. If it is not effective in minimizing erosion or the release of storm water pollutants from the site;
2. If more effective procedures are available and practical;
3. If previous experience has shown the control methods specified have proven to be inadequate in similar circumstances; or
4. To meet basin specific water quality requirements or goals.
5. To correspond to changes in the development plan for the site.
6. In the event of repetitive failure to adequately maintain practices.

9.7.2 SWPPP General Requirements

At a minimum the following shall be provided on the SWPPP.

- Name and address of the owner of the property where the construction activity is proposed; of the land developer; and of the applicant.
- The existing and proposed topography of the site taken at a contour interval sufficiently detailed to define the topography over the entire site.
- Contour intervals sufficient to show on and off-site drainage.
- The site's property limits shown in true location with respect to the plan's topographic information.
- The proposed grading and land disturbance including: surface area involved; limits of grading including limitation of mass clearing and grading whenever possible; and provisions to preserve topsoil and limit disturbance.
- Appropriate and applicable information from FEMA flood maps and federal and state protected wetland maps.
- Specifications for a sequence of construction operations shall be contained on the SWPPP describing the relationship between the implementation and maintenance of sediment controls, including permanent and temporary stabilization and the various stages or phases of earth disturbance and construction. The specifications for the sequence of construction shall, at a minimum, include the following activities:
  a. Clearing and grubbing for those areas necessary for installation of perimeter controls.
  b. Installation of sediment basins and traps.
  c. Construction of perimeter controls.
  d. Remaining clearing and grubbing.
  e. Road grading.
  f. Grading for the remainder of the site.
  g. Utility installation and whether storm drains will be used or blocked until the completion of construction.
  h. Final grading, landscaping, or stabilization.
  i. Operation and maintenance, inspection of practices.
  j. Removal of sediment controls.
- Changes to the sequence of construction operations may be made by the person conducting land disturbing activity or their representative and do not constitute a violation unless measures to control stormwater runoff and sediments are not utilized.
- If the SWPPP is prepared by and carries the seal of a licensed Professional Engineer, Architect, or Landscape Architect; or is prepared by an International Erosion Control Association Certified Professional in Erosion and

Sediment Control (CPESC) it shall be given automatic approval. However, if the SWPPP is prepared by someone other than those listed above the NRD shall review the SWPPP, and after review notify the landowner/land developer of approval or denial within ten (10) days after receipt of the SWPPP. If the SWPPP has been denied, it may be revised and resubmitted for approval. If the approval or denial has not been received within such seven (7) day period by the landowner/land developer, then the SWPPP shall be deemed approved.

- The SWPPP shall include placement of the following statement. "The undersigned certifies this plan has been designed in accordance with the terms of the interlocal agreement for NPDES compliance."

9.7.3 SWPPP Erosion And Sediment Control Requirements

The applicant shall incorporate erosion and sediment control practices into the SWPPP and implement said practices at all locations undergoing construction activity. The erosion and sediment control practices utilized shall consider site specific variables including slope, soil types, the size of the project, the duration of construction activities, the proximity of perennial and seasonal streams, and the existence of impounded waters downstream of the project. The controls utilized may vary from site-to-site, but the controls used shall be effective in minimizing erosion and sediment release from the site, and in protecting the water quality in the receiving stream or water body.

The existence of downstream lakes or other impounded water increases water quality concerns relative to sediment release. In these instances, more stringent erosion and sediment controls may need to be implemented.

The applicant shall upgrade the erosion and sediment control practices utilized in the SWPPP and implement additional controls, if existing controls prove inadequate in minimizing erosion and sediment releases, or in protecting the water quality of the receiving stream or water body. The applicant shall comply with City/NRD requests to implement additional controls to minimize erosion and sediment releases, and to protect receiving water bodies.

Physical erosion and sediment control practices incorporated into the SWPPP shall comply with the requirements of the Nebraska Department of Environmental Quality.

All SWPPP plans submitted for approval shall include the following statement, "Unless otherwise indicated, all vegetative and structural erosion and sediment control practices and stormwater management practices will be constructed and maintained according to the minimum standards and specifications of the City of Lincoln Drainage Criteria Manual.

All of the following practices shall be considered for inclusion in the SWPPP.

a. Construction practices and structural controls to slow storm water runoff and minimize erosion from the site.

   Practices and controls that should be considered for implementation include, but are not limited to the following:

   i) Horizontal slope grading;
   ii) Temporary or permanent terraces, berms, cuts or other physical structures placed horizontal to sloped surfaces;
   iii) Silt fence, bale barriers, check dams or other physical barriers placed at intervals in drainage ways, on sloped surfaces and at property boundaries;
   iv) Geotextile mats, rip rock or other methods to prevent erosion in drainage ways and below conduit outlets; and
   v) Storm drain inlet protection (i.e., gravel filter or silt fence).

b. The schedule of construction activities so as to minimize the extent and time that soils are left unstabilized.

   This shall include, when possible, phased construction planning so as to minimize the area of the site that is not stabilized by vegetative cover, or other temporary or permanent soil covers (e.g., pavement, mulch, or geotextile mats).
   The construction schedule shall take into account areas within the construction site that may be available for reseeding prior to the completion of the overall project.

   Construction activities scheduling shall specify an appropriate time table for initiating sediment retention and erosion controls. When possible, sediment retention controls shall be installed prior to the initiation of clearing and grading activities, and erosion controls shall be implemented concurrent with the initiation of construction activity.

c. The use of existing vegetation and revegetation.

   When possible, existing vegetative covers should be left undisturbed. When possible, vegetative strips shall be

maintained on the down gradient perimeter of sites, and adjacent to waterways and drainage ways that are within the site.

Temporary or permanent seeding shall be established as soon as possible after grading and clearing activities are completed, and during interim periods on areas that are not being actively worked.

d. Contingencies for planned and unplanned work stoppages.

The SWPPP needs to address requirements for stabilizing exposed slopes and stock piles (e.g., the installation of terraces or berms, temporary seeding, etc.) If work on the site is stopped. In instances, where the original project schedule is disrupted, the SWPPP may need to be modified to prevent erosion on exposed soils where grading has been temporarily or permanently discontinued.

e. Storm detention basins.

The need for storm water detention basins is contingent upon the area disturbed and the slope of the site. In general, storm water basins need to be used in disturbed drainage areas of 5 acres or more in size. Where slopes are equal to or steeper than 3:1, storm basins may be required for smaller drainage areas. The use of storm water detention basins does not circumvent the need to implement the erosion and sediment control practices previously cited.

All SWPPP plans submitted for approval shall include placement of the following statement, "following soil disturbance, permanent or temporary stabilization shall be completed within seven (7) calendar days to the surface of all perimeter sediment controls, topsoil stockpiles, and any other disturbed or graded areas on the project site which are not being used for material storage, or on which actual earth moving activities are not being performed." In subdivisions, this permanent or temporary stabilization must be maintained until development commences on street work, utility work on individual lots within the subdivision.

- Sediment basins and traps, perimeter dikes, sediment barriers and other measures intended to trap sediment shall be constructed as a first step in any land disturbing activity and shall be made functional before upslope land disturbance takes place.
- Stabilization measures shall be applied to earthen structures such as dams, dikes and diversions immediately after installation.
- Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion. Slopes that are found to be eroding excessively within one year of permanent stabilization shall be provided with additional slope stabilization measures until the problem is corrected.
- Concentrated runoff shall not flow down cut or fill slopes unless contained within an adequate temporary or permanent channel, flume or slope drain structure.
- All storm sewer inlets that are made operable during construction shall be protected so that sediment laden water cannot enter the conveyance system without first being filtered or otherwise treated to remove sediment.
- Before newly constructed stormwater conveyance channels are made operational, adequate outlet protection and any required temporary or permanent channel lining shall be installed in both the conveyance channel and receiving channel.
- When work in a live watercourse is performed, precautions shall be taken to minimize encroachment, control sediment transport and stabilize the work area to the greatest extent possible during construction. Nonerodible material shall be used for the construction of causeways and cofferdams. Earthen fill may be used for these structures if armored by nonerodible cover materials.
- When live watercourse must be crossed by construction vehicles more than twice in any six month period, a temporary stream crossing constructed of nonerodible material shall be provided.
- The bed and banks of a watercourse shall be stabilized immediately after work in the watercourse is completed.
- Where construction vehicle access routes intersect paved public roads, provisions shall be made to minimize the transport of sediment by vehicular tracking onto the paved surface. Where sediment is transported onto a public road surface, the road shall be cleaned thoroughly at the end of each day. Sediment shall be removed from the roads by shoveling or sweeping and transported to a sediment control disposal area. Street washing shall be allowed only after sediment is removed in this manner. This provision shall apply to individual subdivision lots as well as to larger land disturbing activities.
- All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization

or after the temporary measures are no longer needed, unless otherwise authorized by the implementing agency. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sediment.

9.7.4 SWPPP Inspection And Maintenance Requirements And Enforcement Procedures

- All SWPPP plans submitted for approval shall include placement of the following statement, "All sediment and erosion control practices will be inspected at least once every seven calendar days and after any storm event of greater than 0.5 inches of precipitation during any 24-hour period by responsible personnel. Any necessary repairs or cleanup to maintain the effectiveness of the best management practices shall be made immediately."
- All erosion and sediment control practices shall be maintained in accordance with the requirements specified in the Lower Platte South Natural Resources District Manual of Erosion and Sediment Control and Stormwater Management Standards, dated 1994 and approved supplements.
- By submittal of the SWPPP plan for approval, the applicant certifies the right of the City/NRD to conduct on-site inspections at any time.
- Inspection reports shall be maintained by the City/NRD and shall include the following items:
  a. The date of inspections
  b. The name of the inspector.
  c. Whether the approved SWPPP is being properly implemented and maintained and any practice deficiencies.
  d. Description of needed maintenance.
  e. Action taken.
- The City/NRD shall provide procedures to ensure that deficiencies indicated by inspections are rectified. The procedures shall include the following:
  a. Notification of noncompliance to the landowner/land developer including a "Notice to Cure" which shall set out the deficiencies which shall be cured within five (5) days of receipt of the notice.
  b. Subsequent inspection to ensure completion of repairs upon notification by landowner/land developer that such deficiencies have been cured. If deficiencies have been cured a "Notice to Continue" will be issued.
  c. If landowner/land developer fails to cure deficiencies identified in the "Notice to Cure" then the City/NRD shall issue a stop work order or withhold permission to start work until such time as all deficiencies are corrected, and the City/NRD has inspected and issued a "Notice to Continue".
  d. Initiation of enforcement measures by the City/NRD does not preclude or replace enforcement procedures afforded under federal guidelines.
- Upon completion of the grading, implementation of the SWPPP and permanent stabilization of the site, the landowner/land developer shall submit a "Notice of Completion of Construction Activity" to the City/NRD.
- A final inspection shall be made by the City/NRD for full and final compliance.

9.8 Sample Plan Development

In this section, all of the previous information is put into use to develop an erosion and sediment control plan for a hypothetical housing development. This example is from the state of Virginia; however, its organization, analysis and detail are appropriate for all locations and in accordance with this manual. The original content of this example was retained for continuity. Supporting calculations for the various best management practices are not included for brevity. This section was obtained from the LPSNRD (1994) *Manual of Erosion and Sediment Control and Stormwater Management Standards.*

This example plan was developed in detail for instructive purposes and according to the step by step procedures outlined in Section 9.7. The specific number of maps, practices, drawings, specifications, and calculations required depends on the size and complexity of the development.

STEP 1(a) - DATA COLLECTION (See Map #1)

Topographic Information

Topographic information was obtained by an aerial survey and is shown on the map at a scale of 1"=40' with 5 foot contours.

Natural Drainage Patterns

From on-site inspections and by studying the topographic map, the site was divided into three watersheds, each drained by a distinct swale as shown on Map #2.

Soils

Soils information was obtained from the Soil Survey of the county where the development is occurring. Soil boundaries are shown on the map and each soil type is identified by a symbol.

Ground Cover and Existing Vegetation

An on-site inspection was made to determine the existing vegetation. The site is located in an urban developed area and is heavily wooded. There are areas of hardwood tree growth on the north, east and west sides of the site. Tree lines are shown on the topographic map along with the type of cover on the rest of the site.

Adjacent Property

Center Street borders the property on the west. On the north, there is a two-story commercial building with parking space. On the south, there is a storage building with parking space. To the east, the site borders on an unnamed intermittent stream that runs to Harper's Creek. The developer owns the property on both sides of the stream.

STEP 1(b) - DATA ANALYSIS (See Map #2)

Topography

The site has a relatively flat topography on the western side with gently sloping natural drainage swales to the east. The area between the limits of clearing and the intermittent stream has been designated a critical area and land disturbance in this area should be avoided if possible. A buffer strip of existing vegetation should be preserved.

Drainage Patterns

The site consists of three major drainage areas identified as I, II and III on Map #2. The approximate acreage of each of these areas is also indicated on the map. Each of these areas is drained by a well defined swale. The swales run from west to east and should continue to be used for site drainage if possible. Extreme care should be exercised to control erosion which will occur from any disturbance in or around these swales. For this reason, these swales have been designated as critical areas on Map #2.

Soils (See Map #1)

The predominant soils on the site are Craven fine sandy loam, Uchee loamy sand, and Emporia loamy sand.

The Craven fine sandy loam soils are deep and moderately drained. Typically, the surface layer of this soil is dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer is a pale olive fine sandy loam approximately 5 inches thick. The subsoil extends to a depth of 42 inches The permeability rate of the soil is 0.12 - 0.15 inches per hour, and erodibility factor (K) is 0.32. The hydrological group is C, and the high water table is between 2 - 3 feet.

The Uchee loamy sand consists of well drained Uchee soils. This soil is found on the side slopes of the narrow ridge tops. Typically the surface layer of this soil is dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer is pale olive fine sandy loam approximately 5 inches thick. The subsoil extends to a depth of 42 inches. The permeability rate for this soil is 0.10 - 0.15 inches per hour, and the erodibility factor (K) is 0.24. The hydrological group is A, and the high water table is between 3.5 - 5.0 feet.

The Emporia soil consists of areas of deep well drained soils. This soil is on side slopes along the drainage areas. Typically, the surface layer of this soil is dark grayish brown fine sandy loam about 3 inches thick. The subsurface soil layer is pale brown loam approximately 3 inches thick, and the subsoil extends to a depth of 45 inches. The permeability rate for this soil is 2.0 - 6.0 inches per hour, and the erodibility factor (K) is 0.28. The hydrological group is C, and the high water table is between 3.0 - 4.5 feet.

Ground Cover

The site is now covered by a medium dense tree growth. It is particularly important that trees and undergrowth on the east side of the property be preserved as a buffer area between the site and the stream. For this reason, this area has been identified as a critical area. Land disturbance in this area must be kept to a minimum.

Adjacent Areas

The site drains to an intermittent stream, then to Harper's Creek. There is a high potential during construction for degradation of wetland areas in Harper's Creek from sedimentation. It is important to provide appropriate measures to limit erosion and contain sediment on site during construction. In addition, runoff calculations should be made to determine if there will be an increase in runoff amounts after development, and whether this will result in downstream erosion or flooding.

With regard to other adjacent properties, the developer owns the property on the north and south boundaries of the site, and should suffer no ill effects due to erosion or sedimentation. A natural buffer will be preserved along the edge of the proposed site. The west boundary of the site is Center Street which will be used as access for construction equipment and should be protected from sediment and mud being tracked onto the road surface.

STEP 1(c) - SITE PLAN DEVELOPMENT (See Map #3)

The maps developed for data collection (Map #1) and analysis (Map #2) were used to help determine the most suitable areas for development and the most critical areas from an erosion control standpoint. Erosion potential was one of many factors which were considered in locating the buildings and parking areas.

The final site plan shown on Map #3 was developed through a balanced evaluation of such factors as convenience, drainage, maintenance, costs, aesthetics, erosion potential during construction and stormwater runoff after construction. The following are some considerations which played a role in site planning:

Roads

The only access will be from Center Street since there is existing development on the north and south boundaries of the site and the stream is on the east boundary of the site.

Buildings

The buildings are located on the portion of the site which will require the least amount of cut and fill, and will not encroach into the critical buffer area to the east. This location also allows the natural drainage patterns to be used after development.

Parking Areas

Parking areas were clustered to provide easy access to both the buildings and Center Street.

Drainage

The larger drainage swales on the north and south were preserved. A storm sewer system has been designed to convey

the runoff from impervious areas.

STEP 2 - PLAN FOR EROSION AND SEDIMENT CONTROL
(See Map #4)

As a first step, the limits of grading were outlined on the site plan (Map #4) so that the areas requiring erosion and sediment control practices could be determined. Since construction will take place in three separate drainage areas, the erosion and sediment control planning was considered by drainage area as follows:

Drainage Area I
Land disturbance in this area will consist of grading for three buildings, streets, sidewalks, and lawn. The primary objective in this area is to keep sediment from being transported into the drainage swale and off-site. This will be accomplished by a combination of structural, vegetative, and management practices.

Drainage Area II
Clearing and grading in this area will be limited to disturbance for streets and parking areas. The objective here is to keep the sediment from entering the drainage swale and being transported off-site. This will also be accomplished by structural, vegetative, and management practices.

Drainage Area III
The major portion of the construction for the buildings will take place in this area. Grading will be done for several buildings, sidewalks and lawns. In addition to grading, a storm sewer system will be installed to manage the stormwater runoff after development. Erosion and sediment control techniques will consist of vegetative, structural, and management practices to minimize and trap sediment on site.

Vegetative Measures - Area I, II, and III

1. Topsoil Stockpiling

Topsoil should be stripped from graded areas and stockpiled for use in final grading and permanent stabilization. The stockpiles will have to be kept off-site to stay clear of all construction activity. The stockpile must be stabilized with temporary vegetation to prevent soil loss and sediment transport from the stockpile itself until needed. Prior to land-disturbing activities, the contractor shall submit a supplementary erosion and sediment control plan to the owner covering the off-site stockpile area which would have to be approved by the implementing agency.

2. Temporary Seeding

Certain areas of the site will be rough graded as a first stage of construction. Finish grading will occur near project completion. These areas shall be seeded temporarily with fast germinating temporary grasses to reduce erosion potential. Diversion dikes and the sediment basin embankments shall also receive temporary seeding.

3. Permanent Seeding

Immediately following finish grading, permanent vegetation shall be applied in accordance with an overall landscape plan for the site.

4. Stabilization of Earthen Structures

All earthen structures such as sediment basins, sediment traps, and diversion dikes should be seeded and mulched immediately after being constructed with fast germinating temporary vegetation to help prevent structural damage or failure. This will also help to ensure that the structure itself will not become part of an erosion problem.

Structural Measures - Area I

1. Sediment Basin

Drainage Area I is completely drained by a single swale and portions of drainage areas II and III will be drained by storm sewer into this swale. A sediment basin constructed across the swale below all construction will be the most effective method of removing sediment from the runoff before it leaves the site. The basin will be designed to accommodate the removal of accumulated sediment and to function as a permanent runoff control measure after the site has been stabilized.

2. Check Dam

Rock check dams built across the drainage swale up-slope from the sediment basin will greatly reduce the velocity of runoff from both the construction site and the adjacent property. This measure will reduce ditchline erosion and help increase the effectiveness of the sediment basin by allowing more sediment to settle before the runoff reaches the basin.

3. Diversion Dike

An earthen diversion dike in conjunction with a temporary slope drain will be the most effective method of diverting runoff into the sediment basin.

4. Inlet Protection

Storm sewer inlets will need to be protected to prevent sediment-laden runoff from clogging the sewer pipe during construction. Inlet protection should be used on each inlet until upland areas are stabilized.

5. Silt Fence

Silt fence should be installed downslope of disturbed areas with minimal slopes to filter sheet flow runoff before it enters the drainage swale.

6. Pipe Outlets

Riprap outlet protection should be placed at the discharge end of all storm sewer pipes and from the sediment basins to prevent erosion and scouring at the end of the pipes and to slow the velocity of the stormwater discharge to prevent downstream erosion.

7. Tree Protection

Tree protection fencing should be installed around all areas where existing trees and vegetation are to be preserved to prevent damage and soil compaction from construction equipment and vehicles.

8. Construction Road Stabilization

All roads should be stabilized with crushed stone or aggregate base material to prevent mud from being tracked onto Center Street.

Structural Measures - Area II

1. Sediment Basin

Drainage Area II is completely drained by a single swale. As in Drainage Area I, a sediment basin incorporating a check dam, sediment trap, and diversion dikes will be the most effective method of removing sediment from runoff before it leaves the site. The basin will be designed to accommodate the removal of accumulated sediment and to function as a permanent runoff control measure after the site has been stabilized.

2. Construction Entrance

A construction entrance with a wash rack will be needed to clean the tires of vehicles and equipment during wet conditions. There is high potential for tracking mud and sediment onto Center Street.

3. Construction Road Stabilization

All roads should be stabilized with crushed stone or aggregate base material to prevent mud from being tracked onto Center Street.

4. Storm Sewer Inlets

All storm sewer inlets should be protected to prevent sediment from clogging the storm sewer system pipe.

5. Silt Fence

Silt fence should be installed downslope of disturbed areas to filter sheet flow runoff before it enters the drainage swale.

6. Tree Protection

Tree protection fencing should be installed around areas where trees and other existing vegetation is to be preserved to prevent damage and soil compaction from construction equipment and vehicles.

Structural Measures - Area III

1. Sediment Trap

Drainage Area III is drained by a small less defined swale than Areas I and II. This is also the smallest drainage area of the site. A sediment trap incorporating a diversion dike would be the most effective method of filtering sediment-laden runoff before it leaves the site and enters the drainage swale.

2. Storm Drain Inlets

As in Areas I and II, it is important to provide storm sewer inlet protection around each of the inlets to prevent the system from being clogged with sediment.

Management Strategies - Area I, II and III

1. Construction traffic should be limited to access roads and areas to be graded. All traffic should be prohibited from crossing drainage swales and streams except where absolutely necessary.

2. The sediment basins, diversions dikes, and sediment traps will be installed as a first step in grading.

3. All major grading should be completed within 30 days of the beginning of the project. Temporary seeding shall be applied immediately after grading is completed on the respective areas.

4. Responsibility for plan implementation should be given to the construction superintendent, and he/she should make all construction workers aware of the provisions of the plan.

5. All erosion and sediment control measures shall be checked continuously and especially after each significant storm to locate damages and conduct maintenance operations.

6. After achieving adequate stabilization, temporary erosion and sediment controls will be removed and the sediment basins will be cleaned out and converted to permanent stormwater management basins.

STEP 3 - PREPARE THE PLAN

In steps 1-2, all of the information necessary for preparing an erosion and sediment control plan was developed. In this final step, the actual plan is to be prepared in a logical format containing all the pertinent information. The checklist at

the end of this section was used as a basis for developing the following erosion and sediment control plan. The specification numbers used for each practice in the Narrative, correspond to those used in this Manual.

NARRATIVE PROJECT DESCRIPTION

The purpose of this project is the construction of a new housing complex. The site is located south of Williamsburg, Virginia, on Center Street. The site will consist of construction of eight buildings, parking areas, and lawn. A total of 9.5 acres will be disturbed during construction.

EXISTING SITE CONDITIONS

The proposed site is relatively flat and drains towards the eastern boundary. Most of the site is covered with dense tree growth. The site is divided into three distinct drainage areas as identified on Map #2. Each of these areas is traversed by a distinct swale which drains to the east towards Harper's Creek. The slopes along the swales average between 7 - 10% with some small areas that are 50%.

ADJACENT PROPERTY

Center Street borders the property on the west. On the north, there is a two story commercial building with parking space. On the south, there is a storage building with parking space. To the east, the site borders on an unnamed intermittent stream that runs to Harper's Creek. The developer owns the property on both sides of the stream. Across from Center Street, there is an existing residential neighborhood of single-family dwellings.

OFF-SITE AREAS

Topsoil must be stripped from graded areas and stockpiled for use in final grading and permanent stabilization. The stockpiles will have to be kept off-site to stay clear of all construction activity. The stockpile must be stabilized with temporary vegetation to prevent soil loss and sediment transport from the stockpile itself until needed. Prior to land-disturbing activities, the contractor shall submit a supplementary erosion and sediment control plan to the owner covering the off-site stockpile area which would have to be approved by the implementing agency before any off-site activity commences.

SOILS (See Map #1)

The predominant soils on the site are Craven fine sandy loam, Uchee loamy sand, and Emporia loamy sand.

The Craven fine sandy loam soils are deep and moderately drained. Typically, the surface layer of this soil is dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer is a pale olive fine sandy loam approximately 5 inches thick. The subsoil extends to a depth of 42 inches The permeability rate of the soil is 0.12 - 0.15 inches per hour, and erodibility factor (K) is 0.32. The hydrological group is C, and the high water table is between 2 - 3 feet.

The Uchee loamy sand consists of well drained Uchee soils. This soil is found on the side slopes of the narrow ridge tops. Typically the surface layer of this soil is dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer is pale olive fine sandy loam approximately 5 inches thick. The subsoil extends to a depth of 42 inches. The permeability rate for this soil is 0.10 - 0.15 inches per hour, and the erodibility factor (K) is 0.24. The hydrological group is A, and the high water table is between 3.5 - 5.0 feet.

The Emporia soil consists of areas of deep well drained soils. This soil is on side slopes along the drainage areas. Typically, the surface layer of this soil is dark grayish brown fine sandy loam about 3 inches thick. The subsurface soil layer is pale brown loam approximately 3 inches thick, and the subsoil extends to a depth of 45 inches. The permeability rate for this soil is 2.0 - 6.0 inches per hour, and the erodibility factor (K) is 0.28. The hydrological group is C, and the high water table is between 3.0 - 4.5 feet.

CRITICAL EROSION AREAS

Critical areas have been identified on Map #2. The area between the site and the stream has been designated as critical due to drainage into Harper's Creek which lies east of the site. This creek has areas of wetland vegetation which would experience serious degradation if sediment were to leave the site. Therefore, care will be taken to minimize land disturbance in this area, and sediment must be trapped on the site.

EROSION AND SEDIMENT CONTROL MEASURES

Unless otherwise indicated, all vegetative and structural erosion and sediment control practices shall be constructed and maintained according to minimum standards and specifications of this manual.

STRUCTURAL PRACTICES

1. Temporary Diversion Dike - 9.6.6 and Temporary Sediment Trap - 9.6.11

A system of temporary diversion dikes, to direct flow into sediment traps, will be installed below major graded areas as indicated on Map #4. Specific details of the sediment traps are shown on the detail sheet.

2. Temporary Sediment Basins - 9.6.12

Two permanent sediment basins are to be constructed across the swales in drainage areas I and II as indicated on Map #4. Specific dimensions of the embankments and spillways are shown on the detail sheet. Calculations for sediment basins are attached.

3. Outlet Protection - 9.6.5

Riprap is to be placed at the outlet of all pipes as indicated on Map #4 per detail sheet.

4. Silt Fence Barrier - 9.6.2

Silt fence sediment barriers will be installed downslope of areas with minimal grades to filter sediment-laden runoff from sheet flow as indicated on Map #4.

5. Tree Protection - LPSNRD, 1994.

A fence barrier is to be placed around the trees and vegetated areas which will not be disturbed to protect the trees and other vegetation from construction equipment and soil compaction.

6. Temporary Construction Entrance - Section 9.6.8

A temporary construction entrance with a wash rack shall be installed where the access area intersects with Center Street. During muddy conditions, drivers of construction vehicles will be required to wash their wheels before entering the highway.

7. Storm Drain Inlet Protection - Section 9.6.4

All storm sewer inlets shall be protected during construction. Sediment-laden water shall be filtered before entering the storm sewer inlets.

8. Check Dam - 9.6.7

Several rock check dams will be installed upslope of the sediment basins to reduce the velocity of concentrated flows which will help to increase the effectiveness of the sediment basins.

9. Temporary Slope Drain - LPSNRD, 1994.

Temporary slope drains will be installed to protect the fill slopes from rill and gully erosion. The locations of this practice are indicated on Map #4.

VEGETATIVE PRACTICES

1. Topsoiling (Stockpile) - LPSNRD, 1994.

Topsoil will be stripped from areas to be graded and stockpiled for later use. Stockpile locations will be located off-site and are to be stabilized with temporary vegetation. Prior to land-disturbing activities, the contractor shall submit a supplementary erosion and sediment control plan to the owner covering the off-site stockpile area which would have to be approved by the implementing agency before any off-site activity commences.

2. Temporary Seeding - 9.6.13

All denuded areas which will be left dormant for extended periods of time shall be seeded with fast germinating temporary vegetation immediately following grading. Selection of the seed mixture will depend on the time of year it is applied.

3. Erosion Control Blankets - LPSNRD Mulch - 9.6.15

Erosion control blankets will be installed over fill slopes which have been brought to final grade and have been seeded to protect the slopes from rill and gully erosion and to allow seed to germinate properly. Mulch (straw or fiber) will be used on relatively flat areas and will be applied as a second step in the seeding operation.

4. Permanent Seeding - 9.6.14

Immediately following finish grading, permanent vegetation shall be applied in accordance with an overall landscape plan for the site.

MANAGEMENT STRATEGIES

1. Construction will be sequenced so that grading operations can begin and end as quickly as possible.
2. Sediment trapping measures will be installed as a first step in grading and will be seeded and mulched immediately following installation.
3. Temporary seeding or other stabilization will follow immediately after grading.
4. Areas which are not to be disturbed will be clearly marked by flags, signs, etc.
5. The job superintendent shall be responsible for the installation and maintenance of all erosion and sediment control practices.
6. After achieving adequate stabilization, the temporary erosion and sediment controls will be cleaned up and removed and the sediment basins will be cleaned out and converted to permanent stormwater management basins.

PERMANENT STABILIZATION

All areas disturbed by construction shall be stabilized with permanent seeding immediately following finish grading. Seeding shall be done with Kentucky 31 Tall Fescue according to Std. & Spec. 10.6.2, PERMANENT SEEDING, of the Manual. Erosion control blankets will be installed over fill slopes which have been brought to final grade and have been seeded to protect the slopes from rill and gully erosion and to allow seed to germinate properly. Mulch (straw or fiber) will be used on relatively flat areas. In all seeding operations, seed, fertilizer and lime will be applied prior to mulching.

STORMWATER MANAGEMENT

Calculation of runoff before and after development indicates that there will be a net increase in peak runoff as a result of project development. Consequently, stormwater management basins have been designed to detain and release the runoff at the 2-year pre-development rate.

MAINTENANCE

In general, all erosion and sediment control measures will be checked daily and after each significant rainfall. The following items will be checked in particular:

1. The sediment basins will be cleaned out when the level of sediment buildup reaches the cleanout point indicated on the riser pipe.

2. The sediment traps will be checked regularly for sediment cleanout.

3. The gravel outlets will be checked regularly for sediment buildup which will prevent drainage. If the gravel is clogged by sediment, it shall be removed and cleaned or replaced.

4. The silt fence barrier will be checked regularly for undermining or deterioration of the fabric. Sediment shall be removed when the level of sediment deposition reaches half way to the top of the barrier.

5. The seeded areas will be checked regularly to ensure that a good stand is maintained. Areas should be fertilized and re-seeded as needed.

THE PLAN

Attached are design drawings (Maps 1 - 5) that show the specifications contained in the Narrative portion of this example plan.

Checklist for

Sediment and Stormwater Management Control Plans

Narrative

Project Description - Briefly describes the nature and purpose of the land-disturbing activity, and the area (acres) to be disturbed.

Existing site conditions - A description of the existing topography, vegetation and drainage.

Adjacent areas - A description of neighboring areas such as streams, lakes, residential areas, roads, etc., which might be affected by the land disturbance.

Off-site areas - Describe any off-site land disturbing activities that will occur (including borrow sites, waste or surplus areas, etc.). Will any other areas be disturbed?

Soils - A brief description of the soils on the site giving such information as soil name, erodibility, permeability, depth, texture and soil structure.

Critical areas - A description of areas on the site which have potentially serious erosion problems (steep slopes, channels, etc.).

Erosion and sediment control measures - A description of the methods which will be used to control erosion and sedimentation on the site. (Controls shall meet the minimum specified requirements as found in Section 9.6 of this manual).

Permanent Stabilization - A brief description, including specifications, of how the site will be stabilized after construction is completed.

Stormwater runoff and management - Will the developed site cause an increase in peak runoff rates? Will the increase in runoff cause flooding or channel degradation downstream? Describe the strategy to control stormwater runoff.

Site Plan

Vicinity map - A small map locating the site in relation to the surrounding area. Include any landmarks which might assist in locating the site.

Indicate north - The direction of north in relation to the site.

Limits of clearing and grading - Areas which are to be cleared and graded.

Existing contours - The existing contours of the site.

Final contours - Changes to the existing contours, including final drainage patterns.

Existing vegetation - The existing tree lines, grassed areas, or unique vegetation.

Soils - The boundaries of different soil types.

Existing drainage patterns - The dividing lines and the direction of flow for the different drainage areas. Include the size (acreage) of each drainage area.

Site Plan **Continued...**

Critical erosion areas - Areas with potentially serious erosion problems.

Site development - Show all improvements such as buildings, parking lots, access roads, utility roads, etc.

Location of practices - The locations of erosion and sediment controls and stormwater management practices used on the site. Use the standard symbols and abbreviations as noted in Sections 5 and 6 of this manual.

Off-site areas - Identify any off-site land disturbing activities (borrow sites, waste sites, etc.). Show location of erosion controls. (Is there sufficient information to assure adequate protection and stabilization?)

Details

Detailed drawings - Enlarged, dimensioned drawings of such key features as sediment basin risers, energy dissipators, and waterway cross-sections.

Detailed specifications - Specifications for specific items such as seeding mix and planting schedule, filter fabric size, rock gradations, etc.

Construction sequencing - Specifications for the sequence of construction operations describing the relationship between the implementation and maintenance of sediment controls, including permanent and temporary stabilization and the various stages or phases of earth disturbance and construction.

Maintenance program - A description of inspection schedules, spare materials needed, stockpile locations, instructions for sediment removal and disposal, and for repair of damaged structures should be provided. A clear statement defining maintenance responsibility should also be included.

Calculations

Calculations and assumptions - Provide data for design storm used to size pipes, channels, sediment basins and traps. Include calculations for pre- and post-development runoff as well as any other calculations necessary to support drainage, erosion and sediment, and stormwater management systems.

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